

INTERNATIONAL REVIEW
OF THE
SCIENCE AND PRACTICE
OF
AGRICULTURE

PUBLISHED BY THE INTERNATIONAL INSTITUTE OF

New Series

Vol. I. — No. 3. — July-September 1923



ROME

PRINTING OFFICE OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE

—
1923

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The Editors notes are marked (*Ed.*); the letter *R.* indicates the references to the foregoing issues (Monthly and Quarterly) of the International Review.

ORIGINAL ARTICLES

THE PERIODICITY OF METEOROLOGICAL FACTORS IN RELATION TO AGRICULTURE. (1)

The extension of the network of communication formed by meteorological observation posts, and the multiplication on all sides of records definitely proving the effect of climatic factors on various crops have given rise to a great problem viz., how far it is possible to forecast the weather long enough in advance, in order to know beforehand the variations to which agricultural products will be subjected.

This question arose even before scientists were able to suggest the best apparatus to be used, and at a time when man was forced to rely upon his own direct observation and the traditions handed down to successive generations, which gradually, as time revealed their accuracy, became crystallised into the proverbs current among peasants in general and agriculturists in particular. In most cases, these counsels deal with the agricultural operations necessitated by variations in meteorological phenomena, and are expressed in the form of doggerel verse which renders them easy to remember and spread abroad.

Now, however, that individual observation has been superseded by observations made with the help of instruments that facilitate the recording of many interdependent factors, the great problem of weather-forecasting has again come forward, and the scientists have

(1) In the second number of this Review Sir Daniel Hall has alluded to the wide field for research, offered by Agricultural Meteorology, particularly with reference to the periodicity of the chief meteorological phenomena. Much information on this last question has recently become available, thanks to numerous investigators.

subjected the different data to a minute examination with a view to discovering by means of detailed analysis and with the assistance of mathematics what variations are possible and most probable.

Weather forecasts are divided into two classes: short-term and long-term forecasts. We already know the benefits that agriculturists might obtain from the first, if they took more interest in them and thought them worthy of credence. Now-a-days, meteorologists are in the position to render valuable assistance to the farmers and collaborate with them so as to obtain better crops, for the synoptic weather charts, if properly interpreted according to the different localities, make it possible to forecast the weather for some days, or some hours, but always sufficiently early to enable possible injury to the various crops being greatly lessened.

We will now, however, consider another type of forecast which is the most far-reaching for general purposes and should be combined with the first in order to further improve agricultural production. To be able to predict the rainfall of the successive seasons, and the thermic limits of the various phases of growth, would mean a step forward on the road leading to the stage of maximum development that all regard as the ultimate goal of mankind.

The equatorial regions are the parts of the world which are most suited to these investigations, since they are not subject to the frequent and rapid changes of weather that occur in more temperate zones. In the latter, indeed, swift and even instantaneous disturbances arise, which may be compared to barometric depressions and cyclones, as they quickly alter the regular course of the temperature and the rainfall. Unfortunately it is in the temperate regions that man has constructed his greatest works for utilising the forces of nature and hence he suffers and will suffer more there from seasonal variations until perhaps a more careful analysis of the facts, or further scientific progress, reveals the laws that undoubtedly govern these variations.

The system adopted hitherto for making weather forecasts has been essentially based on the statistical examination of meteorological data collected in various places, and many scientists have tried to establish some connection between the variation in the frequency of sunspots and the variations in certain terrestrial meteorological phenomena. At first, the investigations were directed to the temperature of the air, and the form of the curve representing the thermic variations appeared to be just the converse of that of the sunspot

curve, viz., high temperature corresponded to the minimum number of sunspots and *vice-versa*. This correlation proved very regular in the tropics where the difference between the extreme temperatures is as much as 0.5° C., in high latitudes, however, not only is the variation very slight, but there is a tendency to a secondary oscillation shown by peaks on the curve of the equated thermometric values, and in a periodicity similar to that of the semi-period of the sun spots.

HENRY, in his recent examination of many average variations in the temperature of the atmosphere in the United States and in other countries, found that variations of changing importance and duration frequently occur simultaneously over large areas of the earth, and may present opposite characters when one passes from one region to another. The investigations made to ascertain whether these values were repeated in a systematic manner seem to prove that they recur within 3 or 4 years, or in a period one-third of the duration of the sunspots' period. The range of the variations in the average annual temperature, which seem to have some connection with the number of the sunspots, is one degree in the tropics and decreases towards the poles. The temperature reaches its maximum in the equatorial regions towards the time when the largest number of sunspots occur, but there is no complete synchronism between the two variations.

Similar secondary variations were also noticed by BUCHAN in the annual amount of rainfall and by WALLÉN in the variations of the water-level of some lakes.

HELLMANN, from a study of the variations in the rainfall returns in different cities arrived at the conclusion that throughout Europe no well-marked connection exists between terrestrial and solar phenomena. Most of the Stations recorded two maximum rainfalls occurring in the eleventh period of the sunspots and at an interval of 5 or 6 years apart. The period of fewest sunspots generally corresponds to that of the lowest rainfall, while the range of the variations in the rainfall during a period of solar activity is very slight and sometimes most uncertain.

LOCKYER, who studied the average annual atmospheric pressure in Australia, discovered a 4 years' period similar to the period he had already found to exist in India and South America, and corresponding to a 4 years' frequency cycle of solar protuberances based on the observations of the Italian astronomers.

KLEIN found cirrus clouds to be most numerous during the maxi-

imum period of sunspots, which may perhaps be explained by the greater precipitation of the water vapour in the atmosphere.

BRÜCKNER, who made use, not only of many meteorological observations that had been collected since 1700, but also of indirect proofs of changes in the climate (the traces left by the displacement and retirement of glaciers, the date of the vintage, the opening and closing of navigable channels by the movement of the Polar glaciers, the recurrence of severe winters) succeeded in obtaining data referring to nearly 1000 years. From the examination of this evidence he concludes that the whole earth is subject to climatic variations which are shown as oscillations of cold, damp periods alternating with hot dry periods and form a terrestrial climatic cycle of about 35 years.

BRÜCKNER further deduces from these facts that the periods of rainfall are not synchronous throughout the globe, but that oceanic regions exist where the variations are just the opposite to those occurring in the interior of the continents which he terms temporary, or permanent, exceptions. He also noticed that in the oceanic areas, the variations in rainfall were opposite to those found in continental areas so that a certain compensation seemed to exist at all events as regards rainfall between the continents and the ocean.

BRÜCKNER also discovered that the curves showing variations in the rainfall and the barometric pressure in Europe have an opposite course. He further found that there was no progressive retardation in the rain periods due to changes of latitude, or longitude. HELLMANN, however, noticed that in passing from southern to northern latitudes the time of the maximum and minimum rainfall became later as the latitude became higher.

CLOUGH has proved still more recently that both in the case of rain and temperature, the annual extremes in higher latitudes occur earlier than in the tropics, the average difference being as much as 5 years.

LOCKYER was of opinion that there is a cycle of about 35 years in the variations of the interval between the minimum of sunspots and the following maximum, while WOLFF from his examination of the figures referring to the sunspots from 1750 to today, reached the conclusion that there is no regular periodicity of the sunspots, and sufficient evidence of the existence of the above mentioned 35 years' cycle is also lacking.

NEWCOMB, on the other hand who takes mathematical data as his basis, considers that there must be a constant period for the sun-

spots, and that the discrepancies existing in the data collected are accidental and depend upon errors in observation. CLOUGH shared this view and clearly proved the existence of a cycle of 35 years in the variations of the solar phenomena. He further demonstrated that BRÜCKNER's cycle falls but little later than the eleven years' cycle of the sunspots. This would mean that the duration of BRÜCKNER's cycle is not uniform, but may vary from 25 to 45 years, these variations being synchronous with similar variations in the 36 years' duration of the solar cycle. Should this be the case, the uniformity in the periods of the sunspots, which has been taken as a basis of statistical research by many scientists, is non-existent. In fact, BIGELOW has found that in the meteorological phenomena in the United States, there is an oscillation lasting 3 years, and many other observers, such as MAURER, MOORE, KOEPPEN and NORDMANN have mentioned periods of 7 to 8 years' duration in the variations of temperature, pressure and rainfall.

More recently still CLOUGH, from his investigation of the meteorological and hydrometric data for several rivers in different parts of the United States, has discovered the persistence of a 7 years' period from 1790 to 1919. The duration of this period varied systematically between 4 and 5 years during a cycle of about 25 or 30 years. These variations are synchronous with similar variations in the length of the eleven year period of the sunspots. This period of 7 years tends to predominate as the latitude is higher and the 21 to 22 years' period is a multiple of the 7 and 11 year's periods.

A new method of determining meteorological periods was revealed by the work of DOUGLASS. This is founded on the fact that an intimate connection exists between the annual growth-rings, in the trees and the rainfall of any given place, so that the one can be calculated from the other with an approximation of 8 per cent. DOUGLASS selected for his first studies the pines of the forests of Arizona. Later, he measured various trees in different parts of the United States, South and East England, Norway, Sweden, Germany and Austria, thus obtaining data referring to a period of almost 600 years. From the total of these data he discovered an important correlation with the sunspots cycle.

Dating from 1817, the duration of this cycle may be taken as about 11.7 years, but before that time, it showed certain variations, thus for instance, between 1677 and 1700, the predominant period was 12.5 years. The variations in the sunspots' cycle are exactly repro-

duced in the annual rings of the trees with a delay of one to three years, which shows a close connection between the two sets of phenomena especially in the damp climates of North-West Europe and in the States of North America. A second harmonic cycle of $5\frac{1}{2}$ years is also predominant. Other very distinct periods last respectively 26 months, 22, 34 and 101 years. In the different regions the variations are not the same, this is especially noticeable in the interior of Scandinavia, where they occur in an opposite manner to that recorded on the coast of Norway.

It should be noted that the diagrams showing the annual rings of trees have a great resemblance to the curves of sunspots, but they do not give the rainfall dates of a locality. This is due to the fact that the average measures of many trees have been used in the construction of the curves, so that all local variations are eliminated, further, the annual rings are affected by other meteorological factors, such as temperature.

TURNER, by subjecting to harmonic analysis the heights of the Nile recorded for 700 years found indications of a period varying from 240 to 260 years. From studying the numerous determinations made by DOUGLASS, he discovered a double periodicity, of which the two components had a period of 303 and of 248 years. The interference cycle of these is 4840 years $= 16 \times 303 = 17 \times 284$, so that DOUGLASS's series of measures is not long enough to separate them. The third harmonic of the two interfering components is clearly marked, being 163 years $= 16 \times 101 = 17 \times 94.5$, so that it can thus be separated. TURNER himself showed the existence of an earthquake period which lasts from 14.842 to 14.849 years.

ALTER discovered that the said period can be calculated from the period of the sunspots. In fact, by multiplying 14.8 by 9 and dividing by 12 (the number of months in the year) we get 11.3, which is the average period of the sunspots for one hundred years. Subsequently, ALTER wished to confirm the existence of this period by the evidence of the amount of rainfall. For this purpose he used data from 42 areas of the United States, considering them under the three separate heads of Eastern, Central and Western. The curve for all three groups were very similar which shows that the variation is not to be attributed to an accident, but to real periodicity.

MARVIN criticises this method on the grounds that the data examined do not apply to the same period, or to a sufficient number of years. From a rapid study of the question made some years ago,

MARVIN is convinced that the greatest and smallest anomalies of the meteorological factors are almost always associated with the various conditions of the general circulation of the atmosphere. The accurate interpretation of these correlations which are probably fundamental, cannot be based on short and incomplete observations in the manner attempted by ALTER.

BROOKS, in treating of secular climatic variation, shows that the whole globe may be divided into two types of climatic areas : A) those directly dependent upon the heat of the sun ; B) those where the variations depend upon differences in the circulation of the air (temperate regions, temporary, permanent, cyclonic subtropical regions). Thus, only in the regions of class A, can there exist any correlation between the meteorological phenomena and the variations in solar radiation.

MELDRUM examined the relation between sunspots and the course of tropical cyclones. Later, POEY, WOLF and SARASORA made investigations of the same kind. Statistical studies were carried out by MERECKI, MAUNDER, LOOMIS, SEKIGUTI and more recently, by HUNTINGTON.

STÖRMER and DEELEY have treated of the question theoretically. SIN-ITI-KUNITOMI and HIKOTARI TAKO considered the correlation between the variations in the sunspots and the rainfall.

Other scientists have not contented themselves with the study of a single meteorological factor, but have taken into account the effect of nearly all the atmospheric phenomena upon plants, especially those, which like cereals have a particular economic importance. CHAMBER found in India, that food cereals yield heavier crops in years when there is a large number of sunspots. Recently, however, exhaustive researches have been conducted by Sir W. H. BEVERIDGE, who took the prices of wheat in past centuries as a proof of the abundant supply and therefore of the meteorological conditions during the years in question. He first studied the fluctuations in the prices of wheat in Western Europe, beginning from 1550, and took as an index of the price each year the average price calculated for a 31 years' period of which the year under consideration was the centre. On subjecting to harmonical analysis the figures thus obtained, he tried to find what periods ranging from $2\frac{1}{2}$ years to 84 years could be detected and found the chief periods were two in number, one of 5.1 years (found independently by Capt. BRUNT and J. BAXENDELL) and the other of 35.5 years (Brückner's period). He also deduced 7 other

periods of 5.67 — 9.75 — 12.84 — 15.23 — 19.90 — 54 and 64 years, which he considered as being almost certain; 4 periods varying in length from 3.41 to 8.05 years, in and finally, 5 periods of 11 years that corresponded in stage and duration to the periods of the number of the sunspots.

Since rainfall is rightly regarded as the meteorological factor that has most effect upon the various vegetative stages of wheat, BEVERIDGE, basing his estimate on the amount of rainfall for the period 1850-1921, considered that 11 of the 13 cycles almost certainly exist, and after following out the relative stages and their duration as given by harmonic analysis, he traced out a synthetic graphic curve. The agreement between the two series of data was so close, that he thought himself justified in coming to the following conclusions.

The cereal harvests of Central and Western Europe have been subjected since the middle of the XIX century to a periodic influence, or a combination of such influences, that tend to produce bad crops at intervals of about 15.3 years. This period, although corresponding to certain physical facts, is not permanent, but is due to the combination at this time of two, or more, shorter cycles. These cycles, which are more permanent than their combination, are $A = 4.374$, $B = 5.11$ and probably $C = 2.74$ and $D = 3.71$ years.

BEVERIDGE is of opinion that this research may throw some light upon the near future. The nearest maximum phase of the 15.3 years cycle will occur in 1923; and if the phase is punctual and its effect is marked, the harvests in Europe that year will be generally bad. In the very improbable case that the arithmetic analyses should prove complete and accurate in every detail, 1923 is destined to resemble 1315, the year of the greatest crop failure ever known in European history.

We do not, however, regard this last conclusion of Sir W. H. BEVERIDGE's as well founded, and think he has perhaps over estimated the importance of his work which, although it is of the greatest interest, since it has for its object the economic history of a long period, is unable to give such accurate results as to enable the amount of the harvest in any given year to be estimated. In fact, if we examine the meteorological records for the past months, we find at least as far as Central Europe is concerned, that the rain, the great regulating force of agriculture, already appears to have been distributed in sufficient quantity to insure a good wheat harvest.

Even leaving this factor out of account, the statements made

by BEVERIDGE do not seem to be well-founded. As R. A. FISCHER justly observes, periodicity in harvests must not be regarded as an unfailing proof of periodicity in meteorological phenomena, since it may also depend upon periodicity in economic conditions. In making investigations of this kind it is impossible to foresee the commercial conditions, which may vary from one country to another.

SIMPSON found from his examination of the rainfall data collected during one century in London that the cycle of 35 years is quite insignificant in comparison with the monthly variations. He is of opinion that there must be considerable correlation between sunspots and meteorological phenomena, but since sunspots have no true periodicity, they cannot introduce periodicity in meteorological factors.

SIMPSON is inclined to think that BEVERIDGE may have discovered a certain periodicity in his grain price curve, but doubts the meteorological character of this periodicity which he believes should more rightly be attributed to an economic or biological factor that has affected the harvest in some manner.

Although it is impossible to deny the cogency of SIMPSON's objections, there is no doubt that if these cycles were determined for an extensive region (Central Europe, for instance, as ARNY and JULE suggest) instead of for a single country, the deductions made might have been more in accordance with the facts.

The origin of climatic variations is of a cosmic character, and all students of the subject now think its seat must be in the sun. From many observations made in different parts of the globe, it has been found that at the period of maximum solar activity, there are a large number of sunspots in all the solar latitudes up to 40° north and south of its equator, but when the solar activity afterwards decreases, the sunspots are confined to two constantly narrowing zones in the neighbourhood of the equator. This enormous change, as RICCÒ justly observes, is explained by the assumption that the spots and other solar phenomena are produced like whirlpools in water and whirlwinds in the atmosphere, viz., in the depths of great currents which circulate in 11 years from the high to the low solar latitudes and back again, transporting with them the centres of the complex phenomena which show themselves in that great star.

The sunspots, being less luminous and hot than the rest of the photosphere, give off only about $\frac{1}{3}$ of the amount of heat that emanates from the photosphere in the centre of the solar disc, hence it is probable that their abundance must produce a diminution in

the light and heat radiated by the sun. The figures obtained for the sunspots by WOLF do not reveal any variations during the cycle of 35 years, but BRÜCKNER expresses his conviction that such changes in the solar phenomena must exist, and that the climatic oscillations on the earth are connected with a solar cycle to be discovered in the future, possibly, by means of the variations in the intensity of the radiation.

More recently, HELLAND-HANSEN and NANSSEN from their investigations of the temperature variations in the Atlantic and Indian Oceans, have discovered the existence of a real correlation between the variations in solar activity and meteorological factors. This correlation is greater or less in comparison according to the part of the globe where the observations were made, but the definite laws governing this thermic correlation and its effect upon atmospheric pressure and rainfall have not yet been found.

BROOKS states that a decrease in the number of sunspots is closely connected with a diminution in the total amount of solar radiation. Several years ago, BARTOLI began some researches at Catania on these variations. By means of a series of very accurate calorimetric measures, he sought to determine whether and in what manner, the intensity of solar radiation depends on the number and extension of the spots, faculae and protuberances, *i. e.*, in one word, upon the condition of the surface of the sun. He also tried to determine whether the solar radiation had undergone any changes. Unfortunately, the premature death of the scientist prevented the collection of numerous valuable data which would certainly have prepared our minds for the new conceptions that we have now reached us through the work of ABBOT.

By studying the many determinations of the solar constant made conjointly by FOWLER and ALDRICH for ever 20 years ABBOT found that the so-called, solar constant, or the energy (estimated in calories) which is received per minute by a surface area of 1 cm^2 , at the extreme limit of the earth's atmosphere and serves as a measure of the sun's activity, is not constant. In the different estimates, are found variations, some of short duration (ranging from one or two days to a week) others lasting longer, but all undoubtedly connected with the activity of the sunspots. The average relative value of the period 1902-12 is 1.933 calories, and that of the period 1912-20 is 1.946 calories. The difference between the two values obtained for the solar constant rarely exceeds 10 %, whereas the solar factor

concerned with terrestrial magnetism is subject to variations that may amount to 20 %. Such variations, although small, must have an effect upon the meteorological conditions obtaining on the surface of the globe, but while some observers are of opinion that an increase in temperature results from the greater extension of the sunspots, others, like BIGELOW, believe on the contrary, that the maximum heat in the high region of the atmosphere must cause a maximum number of clouds, and thus provide a screen against heat radiation, with the result that the temperature of the surface of the soil necessarily falls. From the present state of our knowledge of what happens in the sun, we cannot be absolutely certain that an increase in the extension of the sunspots must decrease the temperature on the earth, or that it actually increases it by increasing the amount of radiation. The fact that these spots are accompanied by very brilliant faculae and great eruptions of gas and enormously heated vapours forming protuberances, as well as the correspondence that exists between the larger number of sunspots and the increased activity of all solar phenomena, lead us to think it probable that a decrease in radiation due to dark spots will certainly be compensated for by the increased physical, chemical and electric energy developed in the star and by more gigantic eruptions that bring to the exterior vast masses of gas heated to very high temperatures and thus rendering available a larger amount of the incalculable potential energy present in the huge mass of the sun.

Such considerations leave us sceptical as to the possibility of applying our knowledge of solar periods to any practical purposes, for though from the examination of the natural integral factors of many phenomena, such as those upon which the researches of BRÜCKNER and DOUGLASS are based, we are forced to admit that the existence of solar periods in the past has been proved, we do not consider that we have any reason to think that they can be relied upon as a basis for predicting the future course of phenomena of still greater importance.

Many quite different factors may interfere with the chief factors, and since they may be due to special, and so far, unknown causes, no definite deduction can be made as to their effect.

Although this line of research demands increasing energy from the new workers that with fresh enthusiasm face the difficulties of scientific enquiry, another wider and more promising field has been opened by the recent dynamic investigations which are now being

carried out by means of the extension of the network of State meteorological posts that have been instrumental in diffusing a knowledge of meteorological distribution which occurs in a manner quite unthought of in the past.

The work of HILDEBRANDSON, RYCKEVORSEL and ARCTOWSKI have revealed a hitherto unknown regulating force that appears to direct the meteorological phenomena in different countries. The particulars of the distribution of barometric pressure throughout the globe have made it possible to distinguish areas where the pressure variations are repeated more or less rapidly than in the neighbouring areas. There are, so-called, centres of activity, or wide and extensive areas of high pressure (anticyclones) or smaller areas of low pressure (cyclones). Both are constantly displacing one another, but anticyclones move slowly and often remain in the same latitudes for many weeks.

Weather changes in temperate zones are chiefly due to the formation and breaking up of these small cyclonic areas, usually called barometric depressions, owing to the small difference between the central and the peripheral isobar. There are some regions where such depressions most readily form; many come from the oceans, while others form in places where a suitable orographical arrangement easily causes the temperature to rise above that in the neighbouring areas. The course of these depressions is now well-known; they pass in a direct line generally from the third to the fourth quadrant, but above them certain forces come into play that affect these centres of activity. In fact, the displacement of anticyclonic areas corresponds with an alteration in the usual course of the depressions and a different distribution of rainfall. These areas of high pressure are slowly displaced, so if their relative position can be determined beforehand, it is possible within broad limits to also forecast further changes in the weather, not indeed the annual amount of the rainfall, which has no direct effect upon the size of the crop, but the distribution of the rain throughout the different parts of the year and during the various growth periods. Even if long series of observations are examined, the succession of meteorological phenomena has, it is true, all the appearance of being fortuitous, and the studies made by DOVE, HELLMANN, BORTOLOTTI, ANGOT, MAURER and the writer of this article demonstrated the impossibility of discovering any periodicity of the meteorological characters of the different seasons.

Now, however, it appears to be possible to forecast seasonal variations in rainfall, as well as in temperature. The system employed is radically different from the old method based essentially on statistical data; and rests upon a knowledge of the contemporaneous distribution of meteorological factors over a large surface of the globe, for it has been ascertained that a compensation exists between the climatic variations of one region and those of somewhat distant parts of the world.

The many correlation studies made by HAUN, HELLMANN, PETERSEN, EXNER, OKADA, WALKER LYONS and others have proved the increase in the rainfall and the rise in the temperature of some regions to be contemporaneous with a lower rainfall and a fall of temperature in others. There would appear to be an adjustment around certain localities that form the fulcra, as one might say, of the great oscillating action seen in the whole globe.

In the treatise recently published by SHAW the numerous meteorological problems are illustrated in such a way as to assist interpretation of quantitative variations of different agricultural products, especially those of wheat.

Comparative climatology and the present dynamics of climates can certainly reveal the first signs of the successive variations that now manifest themselves to us in a more visible manner in the displacement of the great masses of ice forming the polar ice-caps. Hence, an increase in the network of meteorological posts of observation in the northern regions would enable us better to follow the centres of activity and to reveal the cycles in which they occur, which certainly vary from one region to another. This would undoubtedly bring us nearer to our goal, the solution of the problem of long-term weather forecasting.

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PHENOLOGY AND AGRICULTURE.

SUCH periodical natural phenomena as are regulated either directly or indirectly by the constant recurrence of cosmic forces acting on them, with special reference to those dependant upon variations of temperature (GANS, p. 357) constitute what is termed the Science of Phenology.

Generally speaking, plants pass through an annual stage of diffusion during which they undergo development in foliage, blossom and fruitage followed by a period of repose. These annual cycles affect the agriculturist, whose labours throughout the year are to a great extent governed by them. For this reason, particular attention is given to such phenomena and for many years past, careful notes have been taken by agricultural scientists of the commencement and duration of such periods of activity. These observations required the initiation of a body of experts whose task it became to endeavour to determine a relationship between certain dates of meteorological importance and those on which the beginning of a period of activity was observed. Among the most energetic pioneers of phenology is to be mentioned Prof. Hermann HOFFMANN, of Giessen (1819-1891). The theory of early phenology was based upon the belief that each individual phase could be made to correspond to the advent of any particular meteorological change and at one time certain phenomena were accepted as facts, merely on account of frequency in occurrence and mass in numbers. It is sufficient to call to mind the tedious investigations undertaken in order to define the limits of vegetation, how, for instance, these limits were thought to be controlled by isothermal lines, regardless of the fact that the developing capacity of any plant is not solely dependant upon climatic forces but also upon its particular pedigree. It is, moreover, doubtful if it were really possible to ascertain whether any species of plant had actually attained the ideal standard of development in its ecological existence.

In studying the theory that climatic influences alone, particularly heat, were responsible for growth, experiments were made in order to determine the mean temperature to which a plant was exposed from a given date to the approximate moment in which it was observed to enter into a phase of development. From the result obtained, this mean temperature was regarded as being constant, irrespective of the time taken to carry out the experiment. (SOLMS LAUBACH). The 1st January was originally taken as the starting point but as soon as it became evident that the duration of the so-called period of inactivity was in no small measure influential over the initial developing stages, this date was altered to the 1st December. (DRUDE, 1890, p. 43). The above methods however, being entirely based on an overrating of a singular factor, namely the absolute degree of temperature in the shade, were rejected by IHNE, KÖPPEN 1871, SCHIMPER 1898, BOS 1906, VAHL 1906, SCHUSTER 1908 and DRUDE 1913 and most energetically opposed by Arnold ENGLER (1905-1913) in respect of their hypothetical laws (GAMS). SOLMS LAUBACH, (1905, p. 60) says: "Judging from facts we know, the mean temperature in which the plant thrives during the experimental period is of far less importance than the determination of a series of *consecutive alternating conditions of temperature* adequate to the progress of expansion. For if the mean temperature exercised such a control over the developing phase, then all other outside influences would fall into insignificance in comparison, or else one would have to admit that their effective powers were much inferior to the standard at which we maintain them to be".

If therefore we are obliged to reject the fundamental principles of early phenology as being unsound, it is evident that very few satisfactory results would be obtained by applying them to practical agriculture. On the other hand, the assiduous observation of facts has brought to light many interesting details. Thus spring-time phenology is intimately associated with the cereal harvest and the certainty of harvest: for instance, in the mountainous areas of central Germany, should the advent of spring be 30 days over due, the cereal harvest will be retarded by about double that time and instead of falling due with more or less clockwork precision sometime between July and August, it will not take place until September, or in extreme cases, in October, when maturing conditions are at their worst owing to cold and damp.

Now if we can conceive the phenology of plants in the sense

given at the beginning of this article and accept it as the doctrine for those recurring phenomena in the vegetable world which are governed either directly or indirectly by cosmic forces: if, moreover, we can completely detach ourselves from the misleading path of mean temperature, modern phenology will assume a different aspect. It will then be clear how with the progress of ecology the science of phenology can gather ever increasing interest and become of real practical importance.

The theoretical fundamental principles of phenology are now totally altered. To-day, the chief problem under discussion among scientists is the origin of those periodical phenomena observed in plant life. Are they the outcome of an essential demand for a change from action to inaction and innate in all animate substance, or are the inactive phases merely attributable to climatic influences occurring annually? Several well-known scientists of latter years prominent among which KLEBS and DRUDE endeavour to throw light on this question by asserting that the origin is to be found in a natural bodily disturbance seeking a sedative in the continual alternation from active to inactive periods regulated, let it be said, by climatic forces.

At this point a question of interest arises as to whether this new phenological problem will allow of a progressive movement in agriculture. In 1922 the author wrote some articles of research which were published in the *Oesterreichische Botanische Zeitschrift* under the title of "Klimarhythmik, Vegetationsrhythmik und Zeitschrift tionsrhythmik" (Rhythm in climatic phenomena, vegetation and plant-formation), which should be of paramount interest to agriculturalists in more respects than one. Before enlarging upon these articles, the author would like to mention that by the term "*Klimarhythmik*" is meant the annual course of meteorological phenomena. In addition to the figures of RAUNKIAR (1910), the annexed chart (Fig. 67) shows the climatic conditions prevalent in Central Europe and in the Mediterranean zone. One constant annual period of growth will be observed in Central Europe, while the Mediterranean area is characterized by two distinct vegetative seasons, Spring and Autumn, interrupted alternately by a cold and a dry season. "*Vegetationsrhythmik*" embodies phenomena in the development of individual plants in the course of the year (foliage, blossoming, ripening), while "*Formationsrhythmik*" signifies collective phenomena occurring in the development of a whole group of plant life. In order to

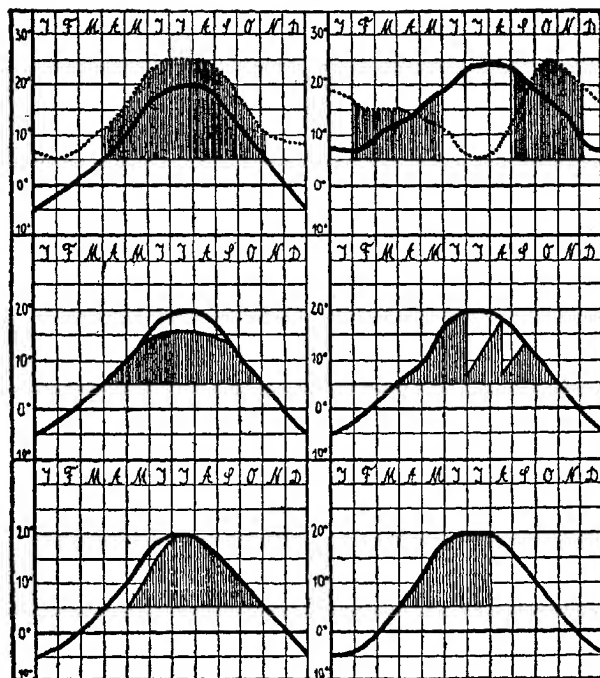


FIG. 67. — Rhythm of Climate and Rhythm of Formation of Central Europe and in Mediterranean Zone.

— Temperature in degrees Centigrade.
 Rainfall.
 [Shaded Area] Period of Growth and Temperature above 5° C.

FIG. 1 (top, left). Rhythm of climate of Central Europe (Graz).

FIG. 2 (top, right). Rhythm of climate in Mediterranean zone (Rome).

FIG. 3 (left, centre). Rhythm of foliage formation.

FIG. 4 (right, centre). Rhythm of meadow-formation.

FIG. 5 (bottom, left). Rhythm of formation of marsh land.

FIG. 6 (bottom, right). Rhythm of field formation.

In Figs 3 to 6 to simplify matters, the course of temperature only is indicated owing to the fact that the temperature and rainfall lines run more or less parallel in Central Europe.

Figs 3 to 6 show that the climatic forces of Central Europe are not utilised to their full extent by the rhythms of foliage (diminution of light, warmth and rainfall in summer), meadow (mowing), moor land (land frozen in spring), and field formation (harvest in August).

(From: SCHARFETTER. *Klimarhythmik, Vegetationsrhythmik und Formationsrhythmik*. *Oesterreichische botanische Zeitschrift*. Vienna, 1922).

follow the author's meaning as closely as possible these terms will be used throughout the remainder of the article. It will be noticed that phenomena in the expansion of individuals and recurring phenomena in plant-formation, the latter being the result of force created by unity, are in no wise identical. On the contrary the very idea of association in vegetable life will suggest new periodical conditions.

As a theoretical working hypothesis, the ideal state can be visualised when perfect harmony exists between "Vegetationsrhythmik" of individuals on the one hand and "Klimarhythmik" actuating in their particular zone on the other, so that in Central Europe, for example, the general rule would be for the development in foliage to occur in April, the blossoming in May and the ripening season in October. Each species of plant would at least be expected to develop to its utmost capacity in the limited time allowed. Facts, however, prove that the succession of developing phases in the vegetable world on the ideal Central European lines described above is but seldom achieved. As a typical illustration of this point, let us refer to the most important products of agriculture, grain crops, as represented by wheat and rye. These cereals do not take full advantage of the developing season peculiar to Central Europe. Wheat sown for instance in summer begins to germinate in March, flourishes in May and ripens early in August. Now it may be observed that already at the end of July it shows all those symptoms which are common to other typical Central European plants in October only, viz. change in colour and desiccation of foliage, ripening of fruit. The ecological causes of these early phenomena are difficult to understand. Heat and moisture are sufficiently abundant to ensure an ever-increasing supply of nutritive matter essential to the growth of the plant yet, in spite of this, it is a fact that *almost one third of the total "Klimarhythmik" is never used up*. It would require too much time and space to go more deeply into the explanation of this phenomena, suffice it to say that wheat can only be cultivated with the most satisfactory results in districts which have a drought in August. True harmony between "Vegetationsrhythmik" in wheat and "Klimarhythmik" can therefore only be found in such districts, namely in Persia and Syria. It is perhaps unwise to expose a plant *capable* of being cultivated partly inside and partly outside of the vegetation radius (autumn wheat) as an example of species in which the "Vegetationsrhythmik" does not blend with the "Klimarhythmik" of Central Europe and no doubt *Colchicum autumnale*, *Leucojum vernum* and

similar types would be more appropriate and would avoid criticism. It was the author's intention, however, to keep within the sphere of cereals, inasmuch as the above mentioned conditions are not altogether wrong. Moreover the phenomena is of much interest and an opportunity will present itself further on to deal with the question of "Formationsrhythmik" and its relation to the soil.

In diametrical contrast to the "Klimarhythmik" of Central Europe is that prevailing in countries in the Mediterranean zone, characterized by two distinct breaks in the vegetative period. It is of fundamental importance to our theory that species known as *Colchicum autumnale*, true to its hereditary "Klimarhythmik", retains the double Spring and Autumn phase in its Central European "Vegetationsrhythmik".

From the preceding examples we get the following axiom: *When the course of "Vegetationsrhythmik" runs parallel to "Klimarhythmik", the plant can be classed as indigenous to that particular region. On the other hand, should there be a divergence in the paths of "Vegetations-" and "Klimarhythmik", then it is probable that the plant is of exotic extraction and conclusions regarding the nature of its native soil can then be drawn through the study of its "Vegetationsrhythmik".*

In opposition to the examples hitherto selected to demonstrate the co-operation between "Vegetationsrhythmik" and "Klimarhythmik" in certain typical cases, our attention is drawn with considerable interest to the question of independent action on the part of recurring climatic forces and phenomena observed in vegetable life. As a large proportion of plants are cultivated on other than native soil, a study of the "Vegetationsrhythmik" of the plant along phenological lines and the "Klimarhythmik" actuating both in its native country and its new surroundings will suggest greater possibilities of cultivation which should be of considerable importance to practical agriculture. The possibilities of cultivation of an exotic plant in new territory depends upon its attitude towards the "Klimarhythmik" of this territory. The hereditary "Vegetationsrhythmik" in any species will be recognised as soon as its origin is determined. In this connection there are three possibilities:

1) The "Vegetationsrhythmik" of the plant in the new region is influenced by a "Klimarhythmik" analogous to the "Klimarhythmik" of its native territory. The habits of the plant in this case undergo no significant alteration and cultivation will present few difficulties if any. A good example is to be found in

Indian corn (*Zea Mays*) indigenous to America, for the simple reason that this cereal adapts itself perfectly to the "Vegetationsrhythmik" of Central Europe already described and unlike wheat and rye makes full use of the time allotted to it to incorporate nutritious matter. *Solanum tuberosum* (Sweet potatoes) and *Nicotiana tabacum* (tobacco) may also be mentioned in this connection. Just to illustrate how beneficial Central European "Klimarhythmik" can be to innumerable American plants (and here by "Klimarhythmik" is meant not only the duration of the developing period, the degree of temperature and rainfall, but more especially the rhythmic succession of climatic phenomena) allusion may be made to the exuberant growth of countless weeds, such as *Galinsoga parviflora* and *Erigeron canadense* and the huge masses of such species as *Solidago* and *Oenothera biennis* which cover railway embankments and river-dykes.

2) The new species adapts itself to the new "Klimarhythmik" without any alteration in its "Vegetationsrhythmik". As has already been pointed out, wheat, in the course of its growth does not necessarily require the full co-operation of Central European climatic forces and therefore in mentioning *Colchicum autumnale* we shall find a far more appropriate example of the case under examination. Corresponding to the "Klimarhythmik" of the native country, the "Vegetationsrhythmik" is divided into two sections: thus the blossoming period is in the Autumn while the ripening season or harvest takes place in the Spring. There is no question of accord between the "Vegetationsrhythmik" and the new "Klimarhythmik" (acclimatisation) but rather of a faculty possessed by the plant to adapt itself to altered circumstances. This faculty is shared not only by a large number of weeds, among which *Papaver rhoeas*, *Agrostemma githago*, *Centaurea cyanus* and others which were introduced into Central Europe together with various kinds of cereals, but also by many Spring plants, which profiting, by the period of light penetration through the foliage of Central European woods are observed in the following order: *Galanthus*, *Leucojum*, *Scilla bifolia*, etc.

3) The newly introduced species yields its "Vegetationsrhythmik" to the new "Klimarhythmik". The change wrought under these circumstances can in the first place consist only in the displacement of individual phases of development. This will apply to all classes of product in which the rhythm is not strongly defined. According to the climatic conditions of various countries into which a

certain kind of plant is being introduced, so the change in the "Vegetationsrhythmik" of that plant can operate in different ways. In support of this statement the American *Robinia pseudoacacia* develops in foliage and blossom at one and the same period in Central Europe, while the same species in Southern Italy will develop first of all in blossom and then form its leaf. (KERNER 1890, I, p. 525). This is probably due to a modification of climate in the former case and a necessity of adaptability to circumstances in the latter. The practice of cultivating wheat and rye in Central Europe appears in a new light. Mention has already been made in the case of *Colchicum* of a spring and autumn phase occurring in the "Klimarhythmik" and consequently in the "Vegetationsrhythmik" of individual plants cultivated in Mediterranean regions. The object in sowing wheat in the autumn is to prolong the developing period and the reason why in Central Europe few difficulties are experienced in cultivating cereals of southern origin, can be explained by the fact that the very extension of this period acts as a stimulant to their natural native tendencies. Curiously enough, this extension is not the outcome of an attempt to cultivate a particular race of cereal capable of ripening at a later season than the end of July but is obtained through leaving or rather allowing a part of the work to be accomplished in the preceding autumn.

What in the case of wheat and rye has been achieved through more or less intentional cultivation has come in a natural way to agricultural weeds, such as *Centaurea cyanus*. This plant is both annual and biennial.

The most important consideration for us is the period of inactivity: If the plant begins to germinate in the spring, it will continue its course of development without interruption until the seed is ripe; should germination take place in the foregoing year, then a period of repose, not however, essential to further development, will set in. (WIESNER 1902, p. 81).

Among the common cereals grown in Central Europe, oats (*Avena sativa*) prior to some ten years ago was merely a summer crop. It was only in 1913, after lengthy experiments in selection and cultivation that the "Oekonomierat" HÜGGELEMEYER succeeded in cultivating a winter variety of oats even when yet partly susceptible to the rigours of winter. HÜGGELEMEYER maintains that the winter crop, in its capacity of producing not only an abundance of grain but also a good quality of straw is of significant agricultural

value. Its early maturing properties enable the field to be cleared earlier than usual preparatory to an after crop (KLER). In addition to this it is a natural enemy of all noxious growth and a participator in the campaign against the troublesome hedge-mustard, closely covering the fields as it does early in the year.

Here let us stop to consider an extremely interesting theoretical problem. The agriculturalist is endeavouring to infect the oats with a "Vegetationsrhythmik" answering to the qualities of "Klimarhythmik" in Mediterranean areas. To us, the reason why such a stubborn resistance to such attempts is displayed by this cereal is comprehensible. Our own theory for the cultivation of winter oats would be the following: start first of all by acclimatising the oats in the Mediterranean areas already referred to, after which transplant them to Central Europe. Various experiments with plants of different seed origin give signs of good results.

A question which now awaits consideration is the following: To what extent are the periodical phases of development able to be regulated? Even though plants of agricultural value have not been selected for experimental purposes, the experiments carried out by DIELS are worthy of comment. DIELS (1917) cultivated various kinds of summer woodland plants in hothouses, during which he observed that the various stages of growth underwent curious changes. With the species known as *Asperula*, it has been discovered that the period of repose can be totally eliminated, while the same period, usually from 8 to 9 months under natural conditions can be shortened to from 2—2 ½ months under artificial heating in respect of *Leucojum*. On the other hand *Polygonatum* can seldom dispense with the inactive season. DIELS does not hesitate to tell us the conclusions he draws from his experiment respecting plant geography. Thus *Asperula* belongs to a family essentially tropical in regard to its developing characteristics. *Leucojum* is regarded genetically as a Mediterranean plant which has preserved its native characteristics during diffusion, all the more so as the plant, true to its native habits, can be made to counteract the resting phase by artificial means, viz. raising of the inactive temperature. *Polygonatum* on the other hand adheres to the inactive period, thereby proving its alliance to a race of plants indigenous to arctic regions, both genetically and in regard to its developing requirements.

Our theory therefore admits from the first the possibility of acclimatisation. It does not, however, always happen that species

of plant life actually do *alter* their "Vegetationsrhythmik" in order to fall in with some "Klimarhythmik" other than their own. In many cases only certain elements in "Klima-" and "Vegetationsrhythmik" which mutually agree, combine. When such cases prevail, a comparison between phenology of the species and the "Klimarhythmik" of the foreign area should be drawn and the relation of the one to the other carefully studied in order to ensure satisfactory results.

We are now in a position to determine, from various suggestions made, which are the species susceptible to adaptability, that is, capable of changing their "Vegetationsrhythmik", and which are not. The author's endeavour in the foregoing paragraphs has been to point out that plants, the origin of which can be traced to regions which have undergone no climatic change for a geological age (Tertiary) possess an inherent "Vegetationsrhythmik" out of which they can be drawn only with difficulty. This is the reason why North-American types display greater tenacity to "Vegetationsrhythmik" compared with Central European types, in which the "Vegetationsrhythmik", owing to changes of climate which have taken place in Central Europe since the Ice Age, is faintly stamped and is therefore comparatively easy to dislodge.

It would be erroneous to imagine that "Klimarhythmik" is the sole factor to be taken into account in plant-formations and particularly agricultural plant-formations. Neither foliage nor moor, field nor meadow in Central Europe would permit a complete state of harmony to exist between "Vegetationsrhythmik" of individual plants and "Klimarhythmik" peculiar to the country. The existence of plants in common, in the light of cultivation, tends to create new conditions, which are of even greater importance than climatic conditions. Let us pass over the Central European formations in respect of foliage and moor and turn our attention briefly to the conditions prevailing in field and meadow.

The mowing of *meadows* causes a check to the normal course of Central European "Klimarhythmik" besides a splitting up of the vegetating season, short as it is, which WETTSTEIN (1904) distinguishes as first low level, first high level, second low level, second high level and third low level. It is not difficult to explain how plants which have thriven under foreign "Klimarhythmik" and formed therefrom a corresponding "Vegetationsrhythmik" are eligible for classification among these plant-formations. *Scilla*, *Lewcojum*, *Gagea* and *Colchicum* are species whose native environment lies in the

Mediterranean zone, while, according to GRADMANN, *Salvia pratensis*, *Coronilla varia*, *Dianthus carthusianorum* are types belonging to the variety of Southern European Steppe plant. Reference is once more made to the fact that comparatively few species have adapted themselves to conditions of growth in the meadows, *i. e.* have changed their "Vegetationsrhythmik" to enable them to live in them; the "Vegetationsrhythmik" of the majority has been sufficiently adequate to the demands of "Formationsrhythmik".

It has already been remarked that the sudden shortening of the vegetation period of plant life in meadows by unnatural causes, the cycle of development in the fields, as also in the cultivated Steppe regions has already run its course by the end of July, owing to adhesion on the part of the plants to "Steppenrhythmik".

The scythe brings the life of plants with Central European "Vegetationsrhythmik" to an untimely end, thus leaving the fields clear for the growth of weeds of South-Eastern European and Pontic extraction. Among the former are classed: *Adonis flammea*, *Asperula arvensis*, *Lepidium draba*, *Muscari comosum* etc., while: *Gagea arvensis*, *Galeopsis pubescens*, *Neslea paniculata*, etc., belong to the latter. Weeds of Mediterranean origin are: *Agrostemma githago*, *Delphinium consolida*, *Papaver rhoeas*, etc.

It can be seen merely from the few examples mentioned in this article, what a vast variety of problems Phenology is capable of presenting, that is, if we regard this science in its true light, namely as the study of periodical development in plants in conjunction with annual climatic phenomena. The science of Phenology promises many important discoveries in connection with possibilities in foreign plant cultivation and holds the key to the origin of innumerable varieties of plant life which abound in our fields and meadows

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THE STATUS OF THE MOVEMENT TO ESTABLISH UNIVERSAL STANDARDS FOR AMERICAN COTTON. (1)

INTRODUCTION.

In the closing days of the last session of the 67th Congress of the United States, the United States Cotton Standards Act, a measure that has been under discussion to a greater or less extent since 1914 was passed. Because of the extended discussions in previous years and the fact that the cotton trade of the United States had been fully consulted, renewed hearings upon the measure were not called for. No opposition of any moment developed in either house of Congress. This law establishes national standards for cotton in the United States. The purpose of this article is to point out the advantages which would accrue to producers, the trade and the public generally, by the adoption of Universal Standards for American Cotton.

FUNDAMENTAL PRINCIPLES.

Before discussing the advantages of the adoption of universal standards for agricultural products in general and cotton in particular, it is perhaps well to state a few axiomatic principles which have an intimate bearing upon the economics of standardization.

1) The price of a particular unit of an agricultural commodity depends in a large measure upon two factors: (a) quantity, and (b) quality.

2) The commercial world has adopted measurements of quantity which are definitely known and are in units which may be

(1) The author gratefully acknowledges the helpful collaboration of Mr. W. R. Meadows, Chief of the Cotton Section of the Bureau of Agricultural Economics, U. S. Department of Agriculture, and his assistant, Mr. A. W. Palmer, in the preparation of this article.

readily expressed with mathematical exactness in terms of the units of each of the several countries. For example, one country may use the pound as a unit of measurement for a given commodity, while another country designates quantity of the same commodity in terms of kilograms. Nevertheless, the relationship between these units is invariable and one may readily be expressed in the equivalent of the other.

3) Without definite measurements of quality or without measurements which can readily be translated into the equivalents in use in the several countries, there can be little comparison of value. In other words: there can be no uniformity in price statistics unless there be a method of comparing measurements of quality as well as measurements of quantity. Quality is one of the inseparable factors of the prices of an agricultural product.

4) The lack of a common language for describing and expressing quality of specific farm products gives rise to endless disputes, costly delays and expensive arbitration proceedings. Universal Standards tend to reduce the possibility of misunderstandings arising over quality.

5) Standardization may be defined as a means of formulating a common and definite language for the measurement of quality.

6) Universal standards require the adoption of a closely supervised system of impartial inspection. Since quality is so intimately connected with price, it is essential that the inspection of grades be not influenced by the special interests of either buyers or sellers.

7) Universal standards also presuppose a neutral system of arbitration for the settlement of disputes over quality. Such a system of arbitration necessitates machinery whereby the interests of buyer and seller are equally represented.

It is assumed that the above seven statements will be accepted without controversy as approximate economic truths.

ADVANTAGES OF UNIVERSAL STANDARDS FOR COTTON.

The desirability for uniform cotton standards as applied to cotton trading in the United States and in fact to trading in American cotton throughout the world, has never been questioned by any well informed part of the cotton industry and trade, from producer to spinner. When it is borne in mind that under former prevailing conditions a wide variety of standards were in use so that

cotton called "Middling" in one market was not middling in another, and that this situation was used to confuse the shipper and in some cases even to defraud him, it is clearly apparent that a single standard applied by a disinterested agency would be of great assistance to the industry.

The desirability of attaining uniform production of the required qualities of cotton in all of the cotton growing states is very apparent. The existence and use of a single standard by which judgment may be guided will tend very greatly to the production of varieties furnishing uniform staple and character. The application of a single standard will also do away with unfair price discriminations, as the grower can now be taught what constitutes the quality and character that gives value which will be the same for long periods, until fundamental conditions in the industry make alterations necessary which in the nature of the case would be slight, in any standard that may be established from time to time.

In the organization of every manufacturing plant in the civilized world, the necessity for economy and efficiency in its processes of operation is so thoroughly understood that it has long been a fundamental consideration. To those who today are giving thoughtful attention to the rebuilding of industry and the re-establishment of normal economic conditions, there appears first of all the need for fresh surveys of all present-day methods of industrial practice to the end that the points where waste and loss occur, that heretofore have escaped notice, may be located and corrective measures taken.

Not only must new economics be devised and applied in the sphere of manufacturing, but the same principles must be followed with equal steadfastness in the field of merchandising. It must be recognized that every extravagance and needless expense in the processes of trade, operate as a tax upon the economic well-being of the world in general and upon the prosperity of those directly interested in particular.

To those familiar with the raw cotton trade in its international phases, faults in the present methods of dealing are very generally and at the same time, very definitely realized. In Liverpool and on the Continent there exists a nomenclature for cotton classification similar to that employed in America, but of which the meaning is markedly different. Under these conditions, it becomes very difficult for the average dealer to make intelligent comparisons of quotations in American and European markets or to form ideas of cotton

values on anything approaching a common basis. As a direct result of these conditions, the sale of cotton by America to Europe is attended with frequent misunderstandings and disputes which at best have usually to be settled by arbitration. Disputes and arbitrations are a form of waste and extravagance that can and should be reduced to the lowest possible minimum. Under existing arrangements, arbitrations are necessarily conducted in widely separated places and by agencies variously constituted, among which there is little community of ideas and no fixed standard of value. The decision of any arbitration committee of to-day is, therefore, of little use to the trade at large, beyond the settlement of the immediate dispute and contributes absolutely nothing to the ultimate solution of the problem of making satisfactory shipments in the first instance.

In the domestic Commerce of the United States, experience has fully demonstrated that disputes can be materially lessened by the adoption of a uniform nomenclature of cotton grades in all the principal markets and by the establishment of uniform and acceptable representations of these grades distributed throughout the country and employed by the trade as a basis on which to conduct its business. Not only are complaints lessened in number by the use of standards, but the adjustment of such disputes as require settlement by arbitration is measurably simplified and facilitated and accomplished with greater satisfaction to the parties at interest.

Having in mind the benefits which have attended the use of standards for cotton grades in the American markets, it seems reasonable to suggest that there is opportunity to effect still greater economies and benefits in international trade by the adoption of uniform standards of grade and staple for American cotton.

It is interesting to note that universal standards of agricultural products are in line with the general tendency of international business procedures. At the recent meeting in Rome of the International Chamber of Commerce, much attention was given to such questions as the use of uniform bills of lading, uniform bills of exchange, and the advocating of uniform custom methods. It is also interesting to note that the International Chamber of Commerce has established an International Board of Arbitration, and that the Chamber strongly urges its members to insert the uniform "arbitration clause" in their contracts covering international transactions.

A BRIEF HISTORY OF THE MOVEMENT
TO SECURE UNIVERSAL COTTON STANDARDS.

Since the American view is based upon American experience in the domestic handling of its greatest export commodity, it may be of interest to trace somewhat in outline the steps leading to the promulgation of standards in the United States and to point out the success that has attended their use in order to explain more fully the present situation and to make clear the position of the American trade and the U. S. Department of Agriculture with respect to it.

Cotton classification originated in Liverpool (1). The earliest known reference to the term "middling" is found in the Liverpool Cotton Brokers' Circular for the year 1801. In 1808 Maury's Price Current classified Sea Island cotton into "fine", "good", "middling" and "ordinary and stained", but referred to Upland cotton only under the names of the countries producing it. In 1833 grade names were used in a loose way for Upland cotton by brokers in the Liverpool market. For instance, New Orleans cotton was quoted under the three designations, "very ordinary to fair", "good fair to good", and "very good to prime".

On June 10, 1874, representatives of American cotton exchanges met in Augusta, Georgia, and, as their most important item of business considered the adoption of a uniform standard of classification of cotton for the United States. A committee was appointed which recommended to the convention the adoption of a "Standard American Classification". This recommendation resulted in the selection of a committee of experts, who agreed on standards which were forwarded to the cotton exchanges of this country. The Standard American Classification was used by most of the exchanges during the season 1874-75 and a part of the following seasons, but in the course of a few years it was discontinued by practically all except the New York Cotton Exchange.

Following the dissolution of the loose association of several cotton exchanges, known as the American Cotton Exchange, and the discontinuance by practically all the leading cotton markets of the Standard American Classification, great diversity developed in the

(1) DE LEACH, R. J. H., History of Cotton Classification. In *Transactions of the National Association of Cotton Manufacturers*, Annual Meeting April 24-25, 1912. No. 92, p. 316.

use of standards. Some markets adopted the Liverpool standards, while other markets adopted as the basis grade of their standards the "fully middling" or the "good middling" of the Liverpool Standard. Some markets established standards based upon, or bearing a direct relation to, the Standard American Classification which was still in use in New York, while other markets created standards entirely their own. Although using identical grade names, no definite relation existed between various standards in use in the cotton belt, and quotations for a specified grade of cotton soon became confused and meaningless unless the standard of a particular market was designated. Even this was not always adequate, as some markets claimed the right of varying the standards from year to year to meet the exigencies of the crop. Thus a standard became a variable measure of quality, and quotations based thereon were confusing and often misleading.

ACTION OF INTERNATIONAL COTTON CONGRESS.

In 1907 the International Cotton Congress, which was composed of cotton growers, spinners, and manufacturers from both Europe and America, at its annual meeting held in Atlanta, Georgia, unanimously passed a resolution favoring the adoption, either by the Government of the United States or by an association composed of representatives of cotton exchanges, cotton growers, and cotton spinners, of standard types for grade and color.

In 1909 Congress authorized the Secretary of Agriculture to establish a standard for nine specified grades of cotton. These were established, their use being entirely permissive.

Between 1833 and 1913 there had grown up in the Liverpool Cotton Association the use of three sets of standards, the exact origin of which is not definitely known. They represented Upland, Gulf and Texas cotton. They seem to have resulted from a process of evolution caused by the increasing necessities of the cotton trade, being built up by the preparation, from time to time, of single types and boxes and not by the adoption of a complete set of standards at any one time. These have always been known as the Liverpool Standards.

In June, 1913, representatives of the Liverpool, Havre, and Bremen exchanges, of the leading American exchanges, and of spinners associations, met in Liverpool. During this conference the so-call-

ed International Standards, which were a modification of the pre-existing Liverpool Standards for Upland cotton, were agreed upon. They were later accepted by the Liverpool Cotton Association as the Liverpool Standards for Upland cotton, and by the Bremen and Havre exchanges, their use being made effective September 1, 1914. Liverpool, however, continued the use of its existing standards for Gulf and Texas cottons. In respect to the distinction between Upland, Gulf, and Texas cottons, there seems to have been a difference of understanding as to the comprehensiveness of the so-called International Standards. Many American merchants apparently understand the International Standards as covering the three growths of cotton, while the foreign exchanges recognized them as applicable only to Upland cotton.

It may be stated that the Liverpool terms "Upland", "Gulf", and "Texas", were formerly more significant of character than they are to day, but with the wider distribution in the American cotton belt of pure seed of single superior varieties, the more extensive adoption of improved methods of culture and handling, coupled with improved facilities for transportation, these old terms have lost most of their significance. Their continued use and acceptance by the European trade is fraught with temptation to deception, cotton frequently being shipped from one section to another so as to enter into the more favored classification. For several years the term "Upland" in the United States has been applied quite generally to all growths of American cotton except, of course, the Sea Island and American-Egyptian varieties, and the American standards for Upland cotton comprehend all growths of such cotton; each type box of such cotton contains samples from all sections of the cotton belt.

ACTION OF REPRESENTATIVES OF AMERICAN EXCHANGES.

On October 27, 1913, representatives of various cotton exchanges in the United States met with the Secretary of Agriculture in Washington, D. C. and urged the adoption by the Department of the so-called International Standards. In May, 1914, a convention, representing nearly all of the cotton exchanges of this country, which assembled at Augusta, Georgia, passed a resolution recommending the acceptance and use of Government standards by all American exchanges and asked the Department of Agriculture, which was entrusted with the preparation and issue of standards, to adopt the International Standards.

THE OFFICIAL COTTON STANDARDS OF THE UNITED STATES.

The United States cotton futures Act of 1914 authorized the Secretary of Agriculture to establish and promulgate standards of cotton by which its quality or value may be judged or determined, including its grade, length of staple, strength of staple, color, and such other qualities, properties, and conditions as may be standardized in practical form, to be known as the "Official Cotton Standards of the United States". The use of the standards established under this act was made practically compulsory on the cotton future exchanges in the United States on and after February 18, 1915.

In preparing standards for grade under the United States cotton futures Act the primary object was to secure comprehensive standards for cotton of American growth which be adapted to the needs of the trade in the United States and at the same time might be suitable for adoption as international or universal standards for American cotton. These standards are therefore almost directly applicable for use under the new law, the Cotton Standards Act.

Cotton experts from New York and New Orleans cotton exchanges were secured to assist the experts in the Department of Agriculture in preparing the new standards. As bases in this work they used the permissive official standards and the so-called International or Liverpool Upland Standards.

VISIT OF REPRESENTATIVES OF THE UNITED STATES DEPARTMENT OF AGRICULTURE TO LIVERPOOL, BREMEN, AND HAVRE, IN 1914-1915.

Prior to the actual promulgation of the official standards provide for in the United States cotton futures Act, cotton specialists went to Liverpool, Bremen, and Havre as official representatives of the Department of Agriculture, for the purpose of explaining the proposed standards for grade and of urging their adoption by the Liverpool Cotton Association, by the Bremen Baumwollbörse, and by the Syndicat du Commerce des Cotons du Havre. The advantages of an agreement at that time by the Liverpool Cotton Association on a uniform standard for international dealings in American cotton were urged in detail.

On November 16, 1914, a special committee of the Liverpool Cotton Association adopted a motion endorsing a single standard

PLATE XVIII.

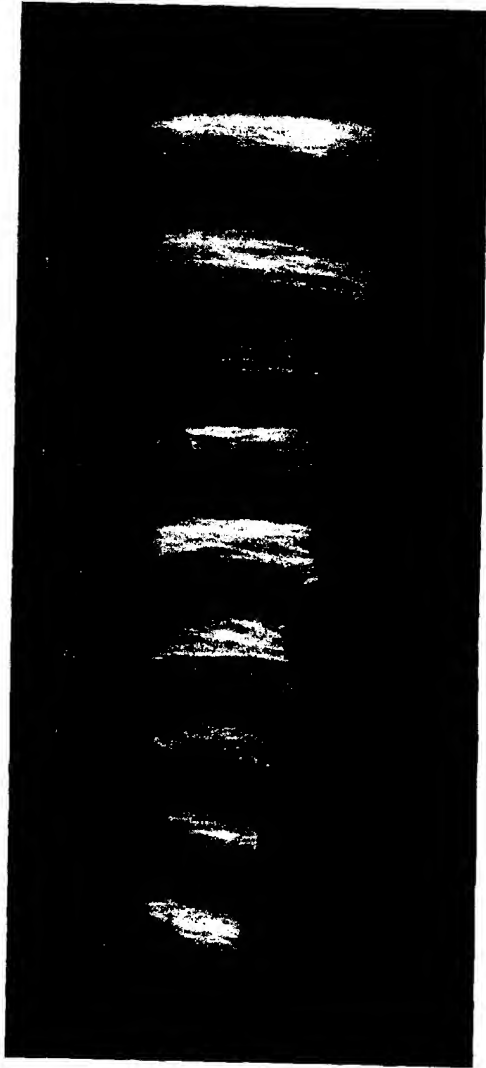


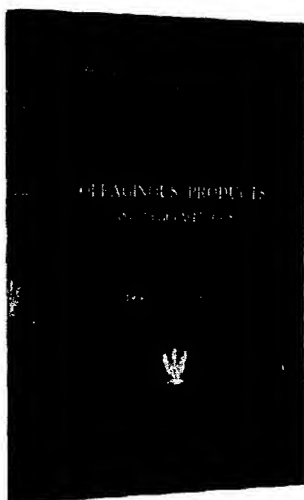
FIG. 67. — A Photographic representation of the Official Cotton Standards of the United States of those lengths of staple for which types are available for distribution, each respective length as shown being obtained from the original type bale.

Note. — Since this photograph was taken types have been prepared for the lengths $1\frac{1}{16}$, $1\frac{3}{16}$, $1\frac{5}{16}$, and $1\frac{7}{16}$ inches, which are also available for distribution.



FIG. 69. — Placing cotton standards in vacuum under supervision of technological laboratory.

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ROME
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1923

Oleaginous Products and Vegetable Oils

The significance attaching at the present time to vegetable oils both as regards production and trade can scarcely be overestimated in view of their importance both for food and industry. Almost all the countries of the world are in one way or another closely interested in the problem of increasing the sources from which these oils can be obtained.

No systematic statement of the information on this question was however available until the publication in September 1921 by the International Institute of Agriculture of *Les Produits oleagineux et Huiles végétales*, a work based on exhaustive research and enquiry and dealing with the subject in full detail. The success of this monograph and the very general wish expressed that it should appear also in English have led to the preparation of an English edition in which all the information has been brought up to date and considerably amplified.

The oil-crops described are mainly those of international interest : cotton, linseed, hemp, colza, sunflower, poppy, castor-oil, groundnut, soya, sesamum, olive, coco-nut, and oil-palm. The book is in two parts.

In the **first part** a concise account is given of the development of the cultivation of oil-yielding crops during the last 50 to 60 years in 170 countries, including in many cases the actual figures of the relative production of vegetable oils. The trade statistics from 1909 to 1922 are added in each case.

The **second part** consists of comparative tables showing the area and production of some of the principal crops, and also the trade since 1909 in all the oil-yielding raw materials and their oils comprised in Part I.

The information is summarised in the **Introduction** with special reference to the variations in the oil-yielding crops and to the fluctuations of the export and import trade in the raw products and resulting oils, occurring as between the war period and the periods before and after the war.

In view of the international importance of the subject it is hoped that this book may prove of general interest as well as of practical value to all who are concerned with vegetable oils from the point of view whether of production or of trade.

.....

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for Upland, Gulf and Texas growths of American Cotton. On November 25, 1914, a committee from the board of managers of the Liverpool Cotton Association informed the representatives of the United States Department of Agriculture that the appeal committee had reported unanimously in favor of the proposed Official Cotton Standards of the United States; that these standards had been unanimously approved by the special committee and had been twice approved by the board of managers; and that, therefore, they stood approved by the Association.

At Bremen, the President of the Bremen Cotton Exchange stated that from the point of view of the Bremen Exchanges, it was desirable that they change their standards from those that had formerly been in use and the President saw no reason why his Exchange should not adopt the proposed standards.

At Havre, the proposed Official Standards were displayed and careful comparisons were made with existing standards in use in Havre. At the conclusion of the conferences, the members participating stated that no criticism of the proposed standards could be made.

WORLD COTTON CONFERENCE AT NEW ORLEANS
IN OCTOBER 1919 AND AT LIVERPOOL IN JUNE 1921.

The New Orleans Conference put itself on record as favoring the adoption and use of a uniform system of classification for American cotton. The World's Cotton Conference of 1921 at Liverpool adopted the following resolutions: "Resolved, that the World's Cotton Conference recommends and will to everything within its powers to facilitate the establishment of uniform standards of classification of American Cotton".

VISITS IN 1921 TO MILAN, ITALY, AND BREMEN, GERMANY.

Following the World's Cotton Conference, the representatives of the United States Department of Agriculture, together with official representatives of the American Cotton trade, visited Milan, Italy, and Bremen, Germany, and discussed with members of the trade organizations at those places the general object of uniform standards. The cotton trade organizations at these two important places officially indicated their approval of the object sought to be accom-

plished and that they would be inclined to take favorable action as soon as circumstances would permit.

During the months of March and April 1922 the writer visited the principal cotton markets of Europe in the interest of Universal Standards for American Cotton. His efforts met with encouraging results.

As recently as April of this year, the International Federation of Master Cotton Spinners unanimously passed the following resolution: "In the opinion of the International Committee the establishment of Universal Cotton Standards would be to the advantage of the Cotton Industry".

WHAT THE NEW UNITED STATES COTTON STANDARD LAW REQUIRES.

The following brief description of the United States Cotton Standards Act will convey the essential features of the Law. It compels every cotton merchant, shipper, buyer and trader in the United States in every transaction or shipment in interstate or foreign commerce, and in every publication of prices, and in quotations of cotton for shipment in interstate and foreign commerce and in the classification of all cotton, to use the official cotton standards of the United States, provided the quality of the cotton involved in the transactions is of, or within the range of, the official cotton standards of the United States.

When the Act becomes effective, bills of lading, warehouse certificates, shipping documents, insurance contracts, newspaper and private quotations of cotton by grade, invoices and all other documents will be required to be stated in accordance with official cotton standards.

The Act further provides in Section 2 that nothing therein shall prevent transactions otherwise lawful by actual sample or on the basis of a private type which is used in good faith and not as a means of evasion of or substitution for the official standards.

Any person who has the custody of, or a financial interest in any cotton, may when the Act comes into full force submit the same or samples thereof, which must be drawn in accordance with the regulations and safeguards imposed by the Secretary of Agriculture, to such officer or officers as the Secretary may designate for a true determination of the classification. The final certificate of the De-

PLATE XX.

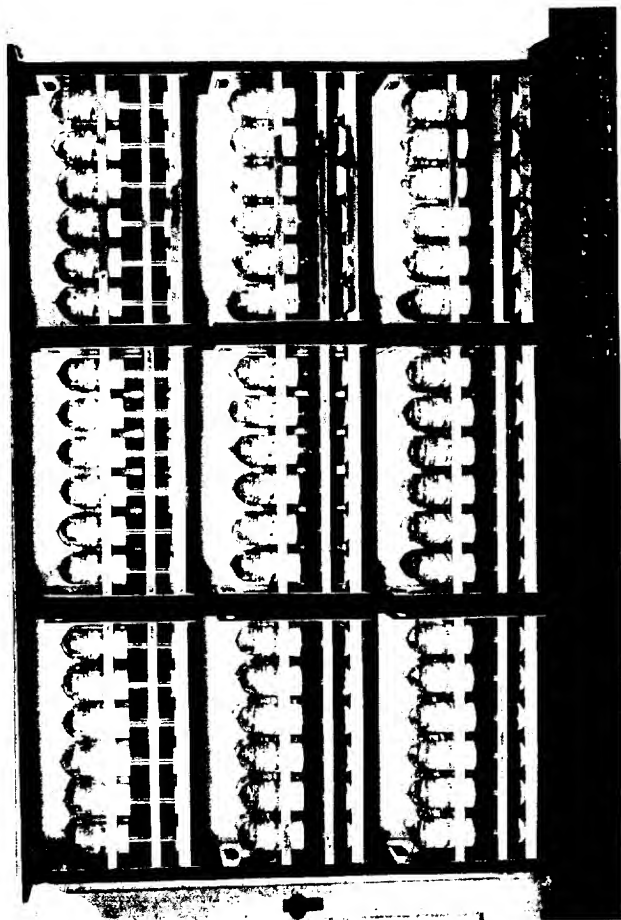


FIG. 70. — Set of 108 vacuum tubes containing a copy of the official cotton standards of the United States.

PLATE XXI.

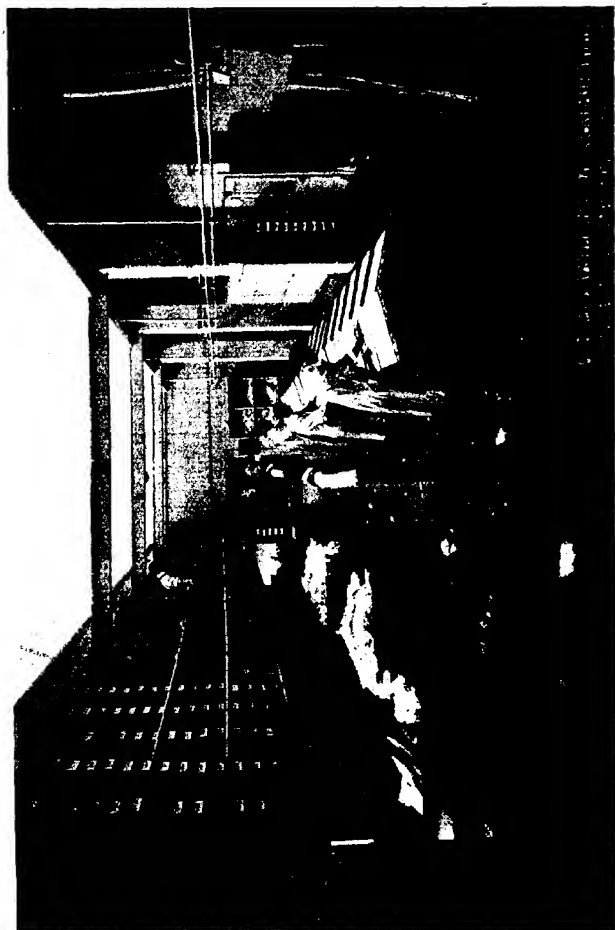


FIG. 71. -- Cotton classification laboratory, final inspection.

partment of Agriculture will be binding on all officers of the United States and will be accepted in the courts of the United States as prima facie evidence of the true classification of the cotton itself or of the sample thereof when involved in any transaction or shipment in interstate or foreign commerce.

The United States Government under the law is authorized to prepare copies of standards and to sell them at cost to any person, whomsoever, requesting the same. These copies are to be certified under the grade seal of the Department, and the attachment of that seal will include regulations for the inspection, condemnation and exchange of standards in order to make certain that copies in use are accurate and suitable for commercial purposes.

Persons who tamper with, alter or change copies of standards excepting those who have the written authority of the United States Government to do so, or who use the standards with intent to deceive or defraud, or who counterfeit or simulate copies of the standards, are subject to a fine of \$1000, or imprisonment or both. The same penalties attach to persons who falsify or forge certificates, or who knowingly classify cotton improperly, and persons who knowingly influence, or attempt to influence improperly the classifiers licensed under the Act.

HOW MAY UNIVERSAL COTTON STANDARDS BE ESTABLISHED.

The above history of standardization shows that although the uniform standards for cotton grades have been made effective throughout the United States and although in principle the adoption of such standards has been approved and recommended on numerous occasions by accredited representatives of the European cotton industry, it remains for Europe to take another step if the advantages of such an arrangement are to be made available for the common good of European spinners and consumers of cotton.

In view of all the circumstances, the simplest and most direct way to bring about the establishment of universal standards for American cotton would appear to be for the cotton exchanges and spinners' associations of Europe to adopt the Official Cotton Standards of the United States for American Upland cotton. By the term "Upland" is meant all growths of cotton produced within the United States, with the exception of the Sea Island and American-Egyptian varieties. In making a proposal for the adoption of the

Official Cotton Standards of the United States as the basis of the world cotton standards for American cotton, there is no implied criticism of any other standards, and the recommendation is made solely for reasons which appear to be sound and fair. Even the present American standards have the sanction and recognition of the laws of the United States, and the Government has spared no expense to provide for and safeguard their accuracy. The standards for grades became legally effective in February, 1915, and have attained general use in the United States in their original form. They govern in all deliveries of cotton on American future exchange contracts, and have been officially adopted by all important American spot cotton exchanges and by the two principal organizations of American spinners. In addition they are recognized in the laws of several of the States, and American producers, merchants and spinners alike have found them a dependable and satisfactory basis on which to conduct their business.

It should perhaps be explained that in advocating the adoption of the Official Cotton Standards of the United States, it is not contended that all of the present standards are perfect, nor that some changes would not prove to be desirable or acceptable. If changes appear to be necessary to any important section of the cotton industry, the United States Department of Agriculture is willing to co-operate in the task of determining proper modifications, the attitude of the Department being that uniformity of the standards is the consideration of greatest importance.

The adoption of uniform standards would in no way prevent or interfere with the practice of any European spinners who buy their supplies of cotton according to their own private marks or types. It is with respect to the vast amount of raw cotton bought on description by Europe from America that uniform standards are needed. The United States Department of Agriculture stands ready now as it has in the past to meet Europe half-way in an effort to eliminate from the international cotton trade the lost motion that is now present. As far as possible merchants and spinners should be freed of the arbitrations and the reclamations that follow. If this should be accomplished, it will be possible for American shippers to sell to European merchants or spinners at prices which will not necessarily include the reclamation which the shipper now anticipates at the time of his sale he may have to pay after the arrival of his shipment in Europe.

PLATE XXII.

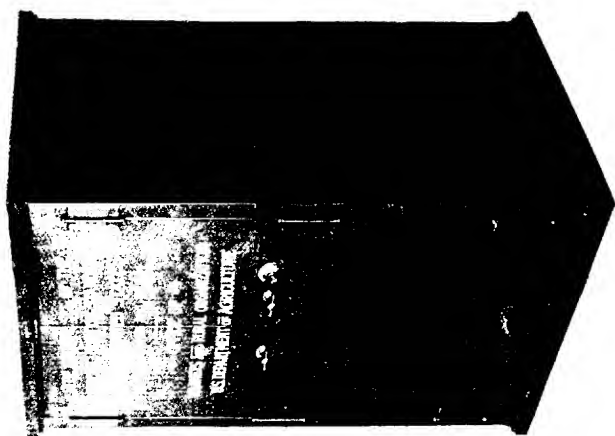


FIG. 72. — Safe containing the first set of cotton standards to be kept at the U. S. Treasury.

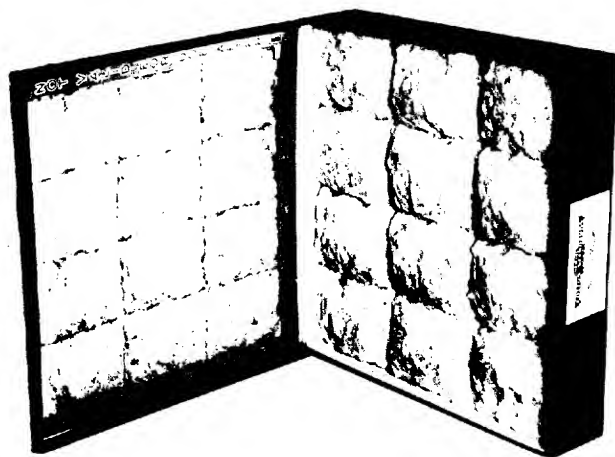


FIG. 73. — Box of Milled cotton, No. 5 of the new standard for white cotton, effective August 1, 1923.

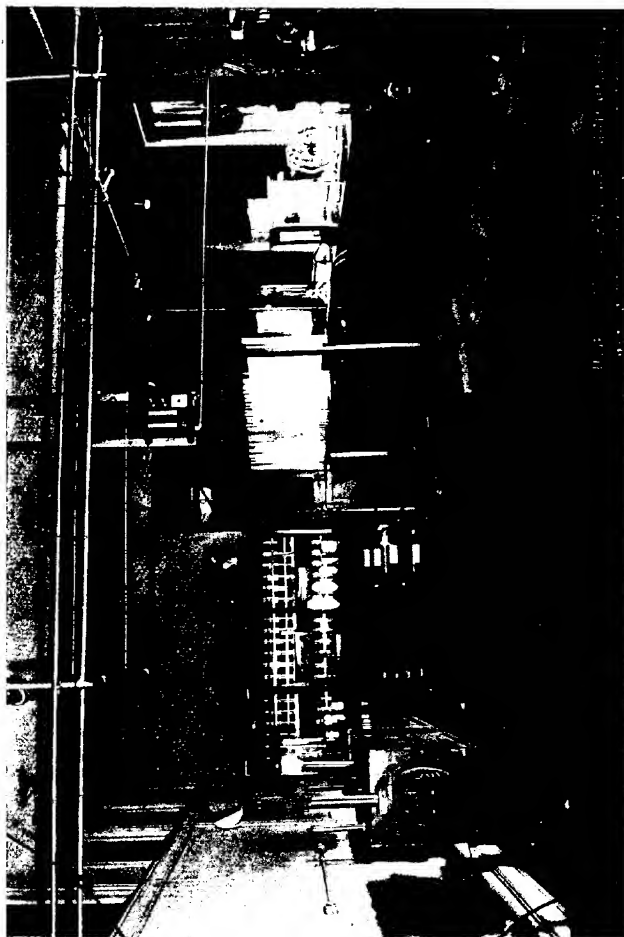


FIG. 74. — Cotton testing laboratory showing yarn tester, rack, scales, automatic humidity control and set of vacuum tubes.

The Official Cotton Standards of the United States for grade, contain type samples taken from actual bales of cotton produced in each of the three sections of the cotton belt, commonly known to the international trade by the terms of Upland, Gulf, and Texas. Copies of these standards are readily available, and they are well known to all American shippers. Means are already at hand by which the proper grade can be determined with practical certainty before shipments are made.

In order to promote a fuller understanding, the United States is ready to furnish demonstration sets and such explanatory as may be necessary in the beginning, without cost to European spinners. It is possible to specify any growth of cotton desired and its grade under one established standard without the necessity of having or maintaining a separate set of standards for each growth. Greater simplicity will result, failure to meet grade requirements will be unjustified, shipments are more likely to be made according to contract terms, and the European spinner can be assured that the cotton purchased is of the grade specified without the necessity for an arbitration after the arrival of the cotton in Europe, with the attendant delay, uncertainties, and expense.

This is not possible under present conditions when there exist in Europe standards different from those in America. The European standards are practically unobtainable in the United States, and the expense is almost prohibitive. Consequently, they are relatively unknown. Among the American shippers who make contracts based on European standards, very few have ever seen these standards or have personal knowledge of their contents. It is not astonishing, therefore, that the present costly, unnecessary, and unsatisfactory system of arbitration is in existence.

The United States Department of Agriculture is the Official agency for the establishment and enforcement of the American official standards for the cotton trade. These standards are prepared and maintained by a non-political organization of impartial and sworn cotton experts drawn directly from the cotton trade, and their work has its sanction and approval. In these proposals, the Government of the United States represents the wishes of the American cotton trade repeatedly expressed by authorized agencies.

It can readily be seen that the United States Department of Agriculture and the American Cotton Trade have been active and have gone far to secure uniform standards and the economies that

would result therefrom, and that, although circumstances over which they have no control have delayed the achievement of this much desired end, its merits are fully established and have been conceded by all concerned. It is evident, however, that the support of the cotton consumers of Europe is important to the final accomplishment of the project.

CHARLES J. BRAND,

*Consulting Specialist in Marketing,
United States Department of Agriculture, Washington, D. C.*

PLOUGHING WITHOUT TURNING THE FURROW, IN AUSTRIA.

In Austria, at the present time, the fields are prepared for sowing almost exclusively by means of ploughs that invert the soil.

On the small area of level ground, iron ploughs are used, these being drawn on the larger farms by steam engines, or motor-tractors. In a few places, ploughs made partly of wood are still employed, while in the mountain districts, and wherever the ground is more or less sloping, turn-wrest ploughs are preferred. Here and there ploughs that do not turn the furrow, but only break up and pulverise the soil are also to be found, but the work of these implements is very incomplete, untouched strips being frequently left, especially in the subsoil. Further, they only break up a thin layer of soil, so that the seed-bed is of little depth and there is only a limited reserve of moisture for the crop. Since there exists in Austria an increasing tendency to cultivate more profitable crops of better quality which are *naturally more exacting as regards their soil requirements, and* the climate is of a pronounced continental character (with prolonged drought during the greatest heat of the summer), it will be easily understood that this primitive method of ploughing, which is totally inadequate to present day requirements is gradually being discarded, although it has the advantage of preparing a good seed-bed, and its place is being taken by modern implements that turn the furrows.

The land on well-managed farms in Austria is generally prepared for sowing in the following manner. As soon as possible after the harvest is carried, a superficial ploughing is given, the field being ploughed to a greater depth before the winter, and cereals are sown. If hoed crops are to be grown the next year, the soil is ploughed as deeply as possible before the winter. Very large clods are thus formed, especially on compact soils and in damp seasons, but this is not regarded as a drawback, for it is hoped that they will be

broken up by the frost in winter and the land left in a mellow condition (1).

Such generally speaking, are the present conditions found more or less everywhere according to the intensity of cultivation and the competence of the farmer, although local differences of course exist. Thus, where the subterranean water is near the surface, narrow, high ridges are made, separated by wide furrows that remain unsown and serve to collect the rain-water. On slopes with compact soil narrow ridges are ploughed and the trenches between them follow to some extent the curve of the ground, in order to prevent the soil being washed away. In mountain districts it is often necessary to run the plough over the field in the spring and carry back, in little carts, the soil that the rains have washed down from the highest points to the lower levels during the winter. In some places, the peasants replace all the soil that has been carried away by the rain.

In time, however, it was recognised that excessively large clods have great disadvantages, for they frequently remain intact throughout the winter, thus making it very difficult to prepare the spring seed-bed, further, they cause an irregular absorption of water, for while the external surfaces of the clods are disintegrated and softened, the nucleus remains relatively dry. When the field is levelled in spring, it not infrequently happens that particles of fine, damp soil fall between the clods and that solid blocks of earth are left on the tilled soil, which causes irregular germination. In the damp, finely divided soil, the seeds come up well and quickly, but in the dry parts of the field, germination is hindered and the seedlings are often smothered by more rapidly-growing weeds, or destroyed by the enemies of cultivated plants. It is clear that such irregular and defective germination will have a bad effect upon the growth of the crop and will interfere with the cultural operations. Much work on the part of animals and men is frequently necessary in order to break up the compact clods resulting from the habitual methods of ploughing. Clod-crushers, harrows and rammers are all needed, which renders the work more laborious and decreases the profits, but this extra outlay is indispensable, as a good seed bed must be secured. The realisation of this fact led to the elaboration of a system of ploughing (first adopted by the large land-owner, KUFFNER on his own estate of Dioseg) which differs from the preceding

(1) KRAFFT DR. GUIDO. Die Ackerbaulehre. Neue Auflage, herausgegeben von Fruhwirth, Berlin.

method in so far that the clods produced by the deep ploughing are already broken up in the winter by a cultivator. Therefore the field passes the winter in a better condition, the surface being mostly broken up, and only a few small clods remaining. This of course renders the spring work much simpler and more complete, while sowing can be done earlier and more rapidly, and germination is both more uniform and more vigorous (1).

This system of ploughing was tried between 1870 and 1880 and afterwards somewhat improved; but although its advantages were clearly evident, it was in general but little practised.

Friederich GLANZ, "Guterinspektor" (agricultural inspector) influenced by the experiments conducted under this system, and the results obtained from similar trials in Germany (2) as well as by the JEAN ploughing method, has devised a new system for which he is making active propaganda under the name of "Wählerarbeit" (3) that is to say, "breaking up". This method, which is distinguished from ordinary ploughing by the fact that the furrow is not turned, is now being tried throughout a large part of Austria and is being adopted in various Agricultural Experiment Stations and on many farms, and is already employed in practical agriculture (4).

The GLANZ method is based on the principle that it is necessary to avoid making clods, which are extremely difficult to break up. Further, the soil must be ploughed in such a manner that a good seed-bed is always preserved and is not destroyed to be remade by working the land into unnatural conditions, which are produced especially by turning the furrow, and show themselves by the formation of clods, or a crust.

Therefore after proper working, the land must not be allowed to return to a bad state.

Breaking up the soil is part of the JEAN system, which cannot be applied in its entirety in a climate damper than that of Austria.

(1) KUFFMER Rudolf. Grundprinzipien der Wirtschaftsweiser der Dioeser Ökonomie. Zuckerfabriks und Spiritusfabriks A. G. Prestburg. Einverlag, 1920.

(2) TOPFER. Anleitung zur Bodenarbeit und Saatzflege. Berlin, 1915.

ASCHENBACH-KANYSATIG. Der Ackerbau ohne Bodenwendung. Naumann, 1921.

DROOP. Die Brache in der modernen Landwirtschaft. Heidelberg, 1900.

DROOP. Neuere Bannen in der Landwirtschaft. Heidelberg, 1903.

RÜCKER Tagesfragen aus dem modernen Ackerbau, Der Boden, Seine Bearbeitung und Düngung. Berlin, 1907.

RIPPART Erfahrungen in Ackerbau zur Überwindung der Kriegsschäden für Gross- und Kleindrieb (Part 45 of the landwirtschaftliche Hefte). Published by T. Kliestling. Berlin.

(3) See R., 1916, No. 386.

(4) GLANZ Friederich. Die Wählerarbeit im Ackerboden. Vienna, 1922.

In fact, it necessitates a certain interval being left between the harvest and the re-preparation of the soil, and this is only possible when the harvest is very early and the land is not prepared until very late, a state of affairs that usually occurs only in countries with long, hot summers, and not in Austria, where the hot season is relatively short (in various mountainous districts, the harvest is carried after the ground has been prepared for the winter cereals) (1).

Only in a few situations and in very good seasons, would it be possible to make the seed bed in Austria by means of the repeated use of cultivators.

Hence, more intensive work is necessary. GLANZ succeeded in preserving the seed-bed by breaking up the stubble as soon as possible after the harvest, that is to say, by ploughing the field without turning over the soil. Whereas by the old method of working, a very superficial first ploughing was given, in order to induce the rapid germination of the fallen seeds of wheat and weeds, GLANZ recommends "breaking up" the soil as deeply as possible. Since the soil is not turned over and the surface of the field is little changed, the seeds present on the soil are not carried down to a great depth, but merely covered with a thin layer of earth that allows of their germination and (the weeds that spring up are afterwards extirpated by the following ploughing. The breaking up of the ground to a greater depth pulverises the soil very thoroughly, so that it does not shortly return to its former condition as in the case of superficial ploughing. GLANZ attributes the greatest importance to the breaking up of the land as soon as possible after the harvest, for otherwise the soil being exposed to direct insolation dries rapidly and its properties deteriorate (2), but of course it is not always possible to carry out this work to a great depth (the greater the depth, the more time is required) however desirable it may be to reach the lower layers of soil, and rapidity of work must never be sacrificed, to depth of penetration.

The object of the subsequent ploughing should be to insure that the soil does not return to its original bad condition.

(1) All the agricultural periodicals regularly contain discussions on the experiments made and the results obtained with this method of ploughing, as well as enquiries respecting the manner in which it is carried out, also reports of lectures and demonstrations and the appointment of Commissions of Investigation. See: *Wiener landwirtschaftliche Zeitung*; *Nachrichten der deutschen Landwirtschaftsgesellschaft für Österreich*, etc.

(2) FRANCE, R. H. *Das Edaphon*. Stuttgart, 1921. GLANZ, Das Wesen der Bodenbearbeitung. *Landwirtschaftliche Fachpresse*, No. 1, Tetschen, January 1, 1923.

As a rule, an attempt is made to break up the soil to as great a depth as possible, in order to provide a very deep seed-bed which will absorb a large quantity of rain-water and place plenty of nutritive substances within easy reach of the roots. The great object of this method of ploughing is to raise, break up and pulverise all the soil and to remove the crust. None of the upper hardened surface must be left unbroken, therefore the ploughs used must have a wide share, that breaks up the whole furrow. When the land is broken up to a considerable depth, it remains in the required condition longer than if only the surface is affected for which reason deep working is to be preferred to shallow.

The object of the other operations is to still further increase the fineness of the seed-bed and keep it in good condition, therefore the use of a plough that turns over the furrow, or, of any other implement tending to produce an excessively compact structure, or clod formation, must be carefully avoided.

The best implement to be adopted is an ordinary plough from which the mould-board for turning the furrow has been removed. (Plate XXIV, Fig. 75).

According to the size and type of the farm, ploughs (with, or without, mould-board) with animal, motor, or steam-engine traction are employed. Special ploughs constructed by Messrs BIPART of Magdeburg (Germany) and other firms are also used. These consist essentially of a wide share furnished with a movable, chisel-shaped, projecting point that penetrates first into the soil and thus facilitates the work of the share.

In spring, before sowing, cultivators alone are used, hence no attempt is made to completely break up the subsoil. Before seeding, it is well also to employ the clod-breaker, or leveller ("Ackerhobel" literally field-rammer) an old Russian implement that works like a plane, cutting the soil for a width of 1 to 1.25 m. and to a depth of 6 to 10 cm., while at the same time it breaks it up and raises it. This leveller breaks up the upper surface of the soil and compresses the underlying layers to some extent; it can be regulated to work at different depths. At the same time, its cutting edge cleanly severs the roots from the grasses and plants that have grown from any fallen seeds.

The use of wide, light harrows is also recommended; they should be employed chiefly after the seed has come up, and in spring. The harrow is needed to break up the surface crust, prevent excessive

evaporation, and facilitate the absorption of rain-water, the fixation of atmospheric nitrogen, and the giving off of carbon dioxide.

Sometimes a wooden roller is passed over the field before sowing in order to make the soil settle more rapidly, so that the seeds may find a good seed-bed.

Naturally it is necessary to clean and consolidate the soil round the roots of the cereals; the best means of rendering this work easy is to sow in double rows; GIANZ left 9 cm. between each couple and 18 cm. between the different couples. The wider interval allows the hoeing to be effected without any fear of injuring the plants.

Since in this way one row is left unsown out of three, a third of the seed is saved and a higher unit production obtained.

The fact that breaking up the land requires less labour and fewer teams than ordinary ploughing is greatly in its favour. The animals are saved the work of inverting the soil, and there are no clods to be broken by the men.

Practical experiments have shown that by breaking up the soil twice, instead of ploughing it once, a saving of 30 to 40 % of labour is effected. This economy coupled with the elimination of most of the harrowing and rolling, and of all the clod-breaking has the following advantages:

- 1) The number of draught animals can be reduced;
- 2) It is easier to carry out the work at the right time in bad seasons;
- 3) It insures the more rapid and regular growth of the crops, makes the working of the fields during the vegetative season an easier matter and gives a higher unit production especially in years of drought. The relatively short time that breaking up the soil has been practised allows of no general numerical data being given. The simplified Dioseg method, from which, as has already been said, the "breaking up" system was derived gave a maximum unit increase of 15 % in dry years and of 4-11 % in wet years.

The autumn of 1922 was an extraordinarily bad season, but on the farms where the breaking up system had been introduced and nowhere else, the preparation of the soil was finished at the usual time. This was possible because the new system can be applied without any fear of rendering the soil conditions worse, even when the ground is too damp to allow of the use of an ordinary plough.

PLATE XXIV.



FIG. 75. — Two-furrow plough for surface work transformed into a "breaking up" implement by the removal of the mould-boards.

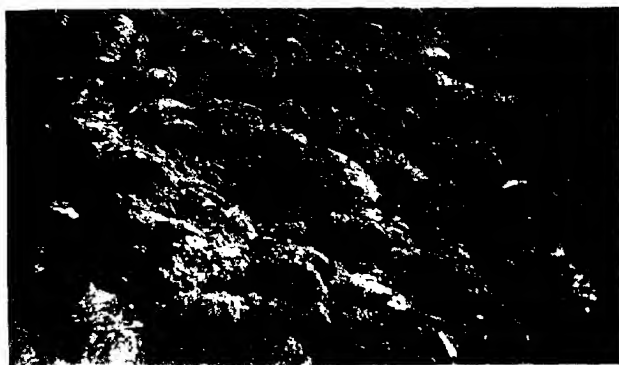


FIG. 76. — Field of beetroots ploughed by turning the furrow.
(Photograph taken January 7, 1923).



FIG. 77. — Field of beetroots ploughed without turning the furrows.
(Photograph taken January 7, 1923).

When the moisture content rises, the soil can be broken up at a later stage than it can be ploughed. The photographs reproduced (see Plate XXIV, Fig. 76-77) were taken on the same day in two adjoining plots. The many bright spots on the ploughed piece show that the work was done in too wet weather, which causes clod formation; in the case of the broken up plot no such spots are seen.

Another advantage in "breaking up" consists in the fact that implements of greater size can be used so that the animals need not go on the furrow or worked ground. In dragging back the empty plough-share they incur less fatigue and there is no fear of their tread producing clods on the soil that has been prepared.

GLANZ advises farm-manure as being the best fertiliser, for the breaking up process only mixes it with a little soil and partially covers it. If straw litter is used, he advocates its being turned in with a disk harrow.

The green manure crops wither as a result of their roots being cut off during the first "breaking up" of the soil; part of the vegetable matter is mixed in then and the rest at the second "breaking up". In the same way, the weeds are removed and go to enrich the soil, but the couch-grass remains on the field, though it is uprooted and freed from some of the adherent soil, but it may be removed by the cultivator that follows the plough used for breaking up the ground. If the cultivator is not preceded by the plough, there is some danger of the couch-grass being only partially removed from the ground, which will be again infested by new plants produced from the fragments that have been left. Naturally it is necessary frequently to remove the pieces of couch grass roots that become impaled on the tines of the cultivator. When the ground is infested with the weed, the cultivator must be used again and followed by a horse-roller. By this means, all the hand-labour is avoided which is indispensable if the soil is turned, for then the roots are broken and most of them are carried down to a greater depth.

Light soils should never be broken up, though this treatment is often adopted in the case of compact soils which rapidly agglomerate. GLANZ also draws attention to the advantage accruing from applying straw litter to soils, especially those of a light type. The ground is covered for a fairly long time with manure, withered weeds, etc. If the soil is then carefully broken up, this protective layer which is very useful, because it prevents the dew evaporating, can well be retained in the surface layer.

The opponents of the "breaking up" system say that straw litter does not make a sufficient covering to the soil and therefore allows loss of nitrogen. Another objection brought forward is that with the implement used it is not possible to thoroughly incorporate the stubble, weeds, manures etc. with the soil, so that the surface of the field does not appear clean. The last observation is not of any particular weight, for according to GLANZ, the losses of nitrogen can be reduced to a minimum by using only chopped straw and short manure.

The theorists insist that the soil colloids and the nutritive substances of the plants, especially lime, are continually transported to lower levels, which is not possible when the furrow is turned, as in this case, substances from the deeper layers are brought to the surface. To this we may reply that the roots penetrate to the deep-seated layers of the subsoil and abstract nutritive substances from them, further in turning the furrow, the plough share does not reach a sufficient depth to be able to bring to the surface the colloids of the subsoil, or any nutritive substances that have been carried down more than a slight depth. Moreover, a thorough ploughing can be intercalated between the "breakings up" of the soil, when it is necessary owing to the surface layer being composed almost entirely of sand, and the clay particles have been carried down to the lower strata (which would certainly only occur after many years). As has already been said, the system of "breaking up" the soil is still in the experimental phase. It is necessary to test it on all types of soil and under all local conditions, and especially in years when the climatic conditions are very different, before any general rules for its application can be formulated.

Thus, it will only be possible to ascertain the effect produced on production and profit by the new method when it has been practised for several years.

The rapid spread of the new system and the animated discussion between its partisans and opponents have, however, aroused the interest of agriculturists in ploughing methods which will do much to solve the various problems involved. There is certainly no doubt that as the present operations leave much to be desired, a better and more thorough ploughing of the fields would increase crop production.

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THE AIMS AND ORGANIZATION OF THE PLANT PATHOLOGICAL SERVICE DOMINION OF CANADA.

In order to comprehend more readily the problems, aims and organization of the phytopathological service of the Dominion of Canada carried on under the Federal Government, as well as the difficulties to be met with, brief reference is here made, by way of introduction, to the exceedingly varying conditions of the country as a whole.

Inasmuch as the Dominion of Canada extends from the Atlantic to the Pacific for a distance of some 3,000 miles, and north and south from Latitude 42° to several degrees beyond the Arctic circle, and as there occur large bodies of inland water, and the altitudes range from sea level to alpine heights of some 19,000 feet and more, one will readily understand the diversity of climatic and related conditions affecting plant life generally.

With brilliant sunshine both summer and winter, with a temperature range from 98-100° F. on hot summers' days to some 50° below zero in some localities, with the heavy precipitations along the coast and areas with desert-like lack of moisture, one can gather some idea of the problems confronting the producers of agricultural or horticultural crops in order to obtain profitable crops, that may be grown so successfully in our Dominion.

From tender, luscious peaches and grapes in our mild regions of Southern Ontario and the fertile valleys of British Columbia, to the hardy varieties of grain and fruits to be found far up north, Canada includes a singularly wide range of crops.

Owing to these conditions it was the principal aim of our organization to establish the closest contact with the actual cultivators throughout the Dominion. Rather than carry the problems of a plant pathological nature to one centre, where climatic conditions may be unsuitable for certain crops and a study of their diseases,

it has been our endeavour to make provision for the study of the diverse problems by establishing a chain of plant pathological laboratories from the east to the west, from south to north. Such organization enables us to keep in close touch with the problems of certain regions; naturally the location of such branch laboratories was made according to representative methods of farming or fruit-growing. It also enables the Department to secure accurate information as to the prevalence of diseases and their economic importance generally and any particular problem individually. As a result of their organization the Dominion of Canada has been enabled to maintain a very close plant disease survey, which is made every year and which conveys a very comprehensive idea of the economic importance of plant diseases as they affect national wealth and prosperity.

The entire plant pathological work is under the direction of the Dominion Botanist, whose office and central laboratories are located on the grounds of the Central Experimental Farm of the federal capital, Ottawa, Ontario. This centre keeps in close touch with each of the branch stations; it is the depository for the results of the year's research data as well as the administrative headquarters of the plant pathological service.

At headquarters the staff consists of the chief officer, experts in physiology and anatomy, leaders in forest pathology, bacterial diseases of plants and laboratory routine. A very considerable correspondence is dealt with from this office; in this manner the central office serves as an inquiry bureau for the cultivators of any kind of crops throughout the Dominion.

A laboratory with up-to-date physical equipment, a fairly comprehensive technical library, greenhouses and experimental grounds, as well as an arboretum of sixty-five acres in extent, are at our disposal for the work.

Besides the general supervision and administration of the work, Ottawa serves as the centre of the plant disease inspection and certification carried on under the Federal Destructive Insect and Pest Act, which includes the administration of the various legislative measures in force directed against the introduction and spread of plant diseases generally, as well as with the inspection of plants for export purposes. In Canada the allied work of entomological nature and that phase of the Destructive Insect and Pest Act relating to

insect pests, is under the jurisdiction of the Entomological Service of the Department.

Research work is undertaken at headquarters on special phases of plant pathology and physiology, such as the relation of temperatures and light to plant life generally, researches on the diseases of forest trees, tobacco diseases and bacterial diseases.

In addition to these phases of work there is directed from headquarters a Dominion-wide system of field and tuber inspection of potatoes for seed purposes. Some idea may be gathered of the extent of this work by stating that, in 1922 an inspection was made of 11,250 acres of potatoes located in various districts throughout the country, from Prince Edward Island to Alberta. This inspection is made according to a very high standard of freedom from disease, and fields which fail to qualify under these standards are given no further consideration for seed purposes. This work has been in progress now for eight years, with the very gratifying result that there is now being produced in the country a large amount of seed potatoes practically free from disease, which has established for itself a wide and favourable reputation not only in Canada but beyond her borders.

The following is an account of the location of our branch laboratories with an indication of the work carried on under local supervision.

Thus, starting from the Atlantic to the Pacific, a laboratory was established in the Gulf of St. Lawrence Province, Prince Edward Island, at Charlottetown. This province is eminently successful in potato growing, and is generally one devoted to mixed farming. Diseases of potatoes — particularly mosaic and leaf roll — root and truck crops are being studied.

At Fredericton, the capital of the Province of New Brunswick, a laboratory is maintained for the study of the general pathology of all crops the principal work being to supply the needs of the locality. The same may be said of a laboratory situated at Ste. Anne de la Pocatière in the Province of Quebec.

Investigational and research work on fruit crops is carried on in widely separated regions, viz., Kentville, N. S.; St. Catharines, Ont.; and Summerland, B. C. Nearly all these areas have their special problems. In Nova Scotia the scientific control of scab of apples and European apple tree canker are important problems,

while at St. Catherines, diseases of small fruits are of principal importance. In British Columbia interesting physiological effects result from irrigation of orchards, and drouth spots, root injury, stippen, etc., may be referred to under this group. One of the important problems of research relates to the successful control of fire blight.

Our next group of laboratories includes those at Winnipeg and Brandon, Man., Indian Head and Saskatoon, Sask. These laboratories are situated in the prize grain belt of the world, with a production of wheat, oats, barley and flax of a value of well over \$650,000,000.

Among specific diseases affecting grain such as smut, root rot, and wilt of flax, etc., the greatest problem remains the black stem rust of wheat, and the laboratories mentioned are co-operating with provincial and university authorities in an endeavour to solve this extremely important problem. There is carried on in conjunction with this problem a wide propaganda to get rid in these provinces of all common barberries and incidentally all European buckthorns to reduce losses from crown rust of oats. Researches so far conducted have revealed the existence in Canada of a considerably number of biologic strains of *Puccinia graminis*. Their discovery, largely due to the painstaking efforts of the officer in charge at Saskatoon, will, it is hoped, facilitate the breeding of rust proof varieties of commercial value similar to our best bread wheats.

Any inquiry relating to any phase of the work here briefly reviewed, should be addressed to the Dominion Botanist, Department of Agriculture, Experimental Farms, Ottawa, who will be glad to render any assistance to workers in other parts of the world.

From the above notes it will be seen that the service which the Dominion Government provides is an organization very similar to the requirements outlined on the occasion of the International Conference on Phytopathology held in Rome in 1914. Apart from the federal service, no special services are maintained by the provincial governments, with the exception of the Province of British Columbia, which maintains a very useful plant disease inspection service in charge of a special officer. With this officer is associated a plant pathologist in charge of work of this nature in British Columbia.

The other provinces maintain advisory services in connection with their agricultural colleges and work in close co-operation with the federal service. Mention may also be made of the valuable

assistance in training of plant pathologists by the Canadian universities and colleges; without such help it would be exceedingly difficult to do justice to the many research problems. At a later date it is hoped to discuss some of the more important phases which also have international aspects.

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Dominion of Canada.*

THE "INK DISEASE" OF THE CHESTNUT.

This disease well deserves its name, for when it attacks the roots of the chestnut tree, a characteristic black substance is formed which extends upwards in the direction of the trunk and downwards to the main radicle system from which it exudes and impregnates the soil, with which it makes a dark-brown paste.

The disease was the object of research and experiment on the part of the late Professors BRIOSI and FARNETI, of the Botanical Institute of Pavia, and of Prof. PETRI, of the Higher Forestry Institute at Florence, for after its first appearance it continued to spread rapidly, in spite of the drought, to which indeed it was erroneously attributed. All the able and ceaseless efforts of Prof. FARNETI who gave his last years to the welfare of his beloved Apennines, were powerless to check the advances of this insidious foe.

The unusual dryness of this summer has been injurious to trees no less than to herbaceous crops, and the chestnut woods of the Emilian Apennines have suffered to such an extent that the minds of the mountain agriculturists have reverted in face of such serious and unexpected damage, to the temporarily forgotten "ink disease".

During the "Settimana del Castagno" (Chestnut Week) at Cuneo, this disease was the subject of much amicable discussion by two eminent phytopathologists, MONTERMARTINI (the inheritor and supporter of the views held by his teachers and colleagues at Pavia) and PETRI (the discoverer of the parasite of the chestnut tree).

The following summary gives the chief characteristics of "ink disease" together with a some brief observations made by the author.

The progress of the infection was not arrested by the experiments carried out by Prof. FARNETI, who hoped by removing the infected roots to restore the equilibrium between the crown of the tree and the radicle system, although he took the precaution to treat the wounds with copper sulphate and sulphuric acid, as well as to cover the cut

surfaces with tar. Another affection sometimes confused with the "ink disease" is "nerume" which disfigures the fruits and only reveals itself at the time they are used. "Nerume" does more damage some years than others according to the extent that the chestnuts are parasitised. Since there is no external difference between the sound and the diseased chestnuts, the latter can be sent to the market without raising any suspicions, and it is only when they are kept in large quantities in damp storehouses, or closed trucks on the frontier, for instance, that they become mouldy and decompose. In such a condition, they cannot be eaten, or used for industrial purposes, as they have an unpleasant smell and nauseating flavour, which is imparted to any substances made from them.

The effects of "nerume" show themselves in this manner to the consumer, whereas the chestnut grower sees the twigs and secondary branches wither as the cankerous bands spread down to invade the largest limbs.

BRIOSI and FARNETI regard *Coryneum perniciosum* as the specific agent of "ink disease", but the French mycologists are of opinion that this fungus is a secondary phenomenon and not the real cause of the infection which seems to descend from the top of the tree to the roots. The two Italian phytopathologists base their opinion of the parasitic character of "ink disease" upon the following facts: the first sign of infection is invariably the withering of the extremities of the branches and of the lower shoots; dark, cankerous bands make their appearance on the affected tree and can be seen upon its external surface; *C. perniciosum* (or other forms of this fungus) are always present on the infected branches. Ink disease can be artificially produced by inoculation with *Coryneum* spores.

PETRI is of opinion that the disease is caused by an external parasite which attacks the tree a little above the level of the ground, in the region of the root-collar, or at the base of the largest roots. He however, considers the specific cause to be *Blepharospora cambivora*, a Saprolegnacea which grows first as a saprophyte on the old cortex of the trunk and produces spores in the presence of water, thus propagating itself rapidly. The oospores formed in the infected tissues of the young plants as soon as the seeds germinate, develop chiefly at the expense of the cambium, and when this is destroyed, the alburnum is quickly invaded by a fungal saprophytic flora the development of which has made it difficult to determine the true source of the disease.

PETRI supports his statements by the following alleged facts almost all of which are contested by BRIOSI and FARNETI. He asserts that: 1) the most seriously injured portion of the tree is always the base of the trunk; 2) collar-rot invariably precedes the parasitic withering of the branches; 3) no continuity exists between the *Coryneum* mycelium and the blackened region at the base of the trunk; 4) the disease with all its characteristic symptoms can be produced by artificial inoculation with the parasitic mycelium.

Coryneum perniciosum and its allied forms find particularly favourable conditions of growth in chestnut-trees already suffering from Ink disease, and without producing any specific primary malady induce a secondary infection. The author himself is inclined to PETRI'S view, which although it has not been confirmed, is the result of much careful investigation, for apart from the fact that the two pathogenetic agents work in contrary directions the one downwards and the other upwards, there is no opposing tendency between them, both being concerned in the destruction of the roots and of the same infected zone of the trunk. Any removal of portions of the tree, except in the usual course of pruning, has not been suggested hitherto, nor does it promise to yield satisfactory results. No useful purpose could further be obtained from an enquiry into the origin of the disease in chestnut woods that have been destroyed, or are in process of perishing, for such an attempt would fail owing to the greater damage inflicted by the War. Experiment plantations, and trial grounds composed of Japanese chestnuts from Japan or the West have all been involved in one common ruin.

The fact that the organic continuity of the parasite on its passage down the tree cannot be followed, and that sound, young shoots may grow out of roots infected with Ink disease would appear to prove that the infection is not transmitted from one set of organs to another and that the two rival theories (according to which the disease does not begin on the roots, but on the branches), are untenable. Therefore much remains still to be done, especially in the way of fieldwork which is much more useful in this connection than laboratory research.

The thorough examination made by FORNETI of chestnut trees subjected to destructive treatment at Cima Lotti, in the Modenese Apennines, has given many contradictory results that are difficult to explain, as during the War these woods were necessarily neglected. Near to individuals in which the disease has been arrest-

ed by the removal of the infected portions, there stand dead, or dying, trees, the object of no less energetic and careful treatment.

FARNETI came across one chestnut which had had been deprived of all its root branches except one, and of a similar amount of its crown; the trunk was propped up by two large curved branches which after eight years still support the mutilated tree that continues to produce leaves and fruit on its remaining boughs. It is fortunate that, so far, the parasite has shown no tendency to spread from the chestnut to other fruit trees. Satisfactory results from the fruit-growing standpoint have been obtained in the Modenese Apennines by substituting good varieties of Italian or French pear and apple-trees for the chestnut, but owing to the lack of adequate and rapid means of transport, the venture has proved a commercial failure, although some of the varieties grown are in no wise inferior in quality to the choice fruit of the Upper Adige. The strong winds that prevail, however, frequently cause the crop to fall before it is sufficiently ripe to be marketable. These technical and commercial conditions combine to make the peasant regret his lost chestnut-trees that furnished him with bread and other products. The reafforestation work of the Federazione Pro Montibus may be able to save both the woods and the mountain dwellers. There is also much to be said in favour of removing the infected portions of the radicle system, for the few remaining roots continue to develop.

It is a curious fact that chestnut-trees are equally attacked whether they grow on dry, sandy soil, or in close proximity to some stream, and as the nature of the soil in mountainous districts changes within very short distances, the disease plays the same havoc on naked sun-baked slopes as in deep, narrow valleys where the transported soil readily collects.

If water is the transporting agent of the disease, we should expect the latter to be most prevalent on the low-lying ground, but the data on this subject are contradictory, for it has been observed that though the immunity of the chestnut increases as the tree reaches the limit of its growth (being considerable at altitudes of 700 to 900 metres and higher) as for instance at Ospitale and Pienarola and in the neighbouring district; the chestnut-trees of Serazzone are almost as much attacked as those of Cima Lotti. At Fontana di Monte Luccio, which lies in a deep wind-protected valley, however, many trees succumb. The author is inclined to regard water as a vehicle of infection, as the disease is most common where

stagnant water collects, and if the ordinary conditions connected with the life of the chestnut are considered it is found that age exercises no definite influence, for while some veteran trees are still thriving, young trees of twenty years of age are found to be already dead. Such a state of affairs is indeed very general, as is proved by the observations made at Cuneo, Mondovi and Saluzzo. It might be expected that irrigation with spring water would contribute to the spread of the disease, but in point of fact, the disease is as severe on dry as on damp soils.

The hypothesis that cropping might lead to a diffusion of the disease as a result of the various cultural operations involved does not seem likely, since on land which is worked and sown with lucern or broom, the chestnut-trees profit by the tillage and grow more vigorously.

Owing to the multiform character of the disease, the author recommends that the dead trees should be destroyed and the land limed, this being the most economical treatment. Young healthy trees can then be planted — preferably Italian chestnuts at first — for if these prove later to be less resistant than the Japanese variety, they can always be used for reafforestation. No new trees ought to be planted in the place of dead specimens. The destruction of the diseased trees may be carried out in the manner adopted by the late Prof. FARNETI; the reconstitution, after the soil has been limed and allowed to rest can be effected according to the usual methods. It is difficult to keep the humus of a chestnut wood free from the mycelium of the parasite without the application of a strong solution of Bordeaux mixture (with the addition of 1-2 % of fish-glue) to the lower portion of the trunks of the infected trees, which is certainly a more costly and troublesome measure than the simple plan of covering the lower part of the trunk with straw, as suggested by GARBASSO.

As regards curative measures, in countries where the chestnut-trees are periodically pruned, the pruning operations are directed by a careful observation of the cankerous, depressed bands descending from the smaller to the larger branches. The internal treatment devised by BRIOSI and FARNETI which consists of making the tree absorb, by means of a special apparatus, exceedingly dilute solutions of sulphate of copper, or of iron (1 in 5000), seems at present to have a merely scientific interest, although it is to be hoped that it may be of practical importance in future.

During the "Chestnut Week" at Cuneo, the following preventive measures were suggested: no live chestnut trees should be allowed to be exported from areas known to be infected; no chestnut-earth should be imported into immune areas; no chestnut leaves or chestnut earth, should be used for manuring nurseries in which are reared young fruit-trees intended to be exported from a Commune that is recognised as being infected.

It is also advisable to sprinkle lime over the leaves collected in heaps for manure, or other purposes and to report to the Phytopathological Institute, the Travelling Agricultural Instructor, or the Forestry Inspection Service any cases of dead trees in the chestnut woods under their supervision, and to fell immediately all dead, or diseased, chestnut trees in areas known to be infected.

All infected stumps should be uprooted and the surface of the ground within a radius of two metres must be disinfected with the solutions of copper previously mentioned. In the case of a considerable extension of the infected area, even if only of recent date, the chestnut-woods that are still healthy ought to be periodically cut down.

The recognition of the necessity for organisation in order to efficiently control the malady has led to the compulsory, or voluntary, creation of Societies for the Protection of Chestnut-woods on the lines laid down by the law of 1913.

The reserve shown by the experts in expressing definite conclusions regarding the subjects treated of at Cuneo was particularly noticeable in the case of the Ink disease. They contented themselves with speaking of the "possible and probable control", a phrase which, while it does great credit to their scientific honesty, leaves us in doubt as to the course to pursue.

With regard to preventive measures, the efficacy of grafting the Italian Chestnut on the Japanese variety (*Castanea mollissima* or "tambu", is still a doubtful question, since the disease resistance of the stock and the graft-affinity between the two varieties are by no means certain.

MANGIN himself, although he agrees with PRUHET in recommending the Japanese chestnut as a stock, allows that decisive results can only be expected after several years.

The grafting experiments made by FARNETI at Fanano did not prove successful, either owing to the probably spurious origin of the Japanese chestnut which perhaps came from America — to want

of graft affinity, or to the fact that the stock being a native of a warm country with a maritime climate, suffered from the continental climate of Italy and the conditions obtaining on our mountains.

Judging by the results of reconstituting phylloxera infected vineyards in Sicily with American stocks, it will require time and experiment to show whether the Japanese chestnut is really resistant to the attacks of *Blepharospora cambivora*, a fungus hitherto unknown in Japan and which, until it attacked our chestnut-trees, was a harmless saprophyte in Italy.

The progress of the Ink disease has been gradual, keeping pace with the gradual adaptation of the fungus to a parasitic mode of existence. Only in the case of the artificially infected chestnut-tree of the Pavia Botanical Gardens did it assume a sudden and violent form.

The most effective control measures will be those based on the life-history of the parasite. Just as in the case of vine-pathology, an empiric remedy (Bordeaux mixture which has now been improved to the point of becoming the sovereign cure of peronospora) was applied, so in that of the chestnut an empiric remedy may be adopted. At Chiusa Posia, all the leaves, chestnut-capsules and other detritus that collect at the foot of the trees are removed and burnt. This might be done elsewhere in the late autumn, when with proper care, there would be no fear of causing forest fires.

With regard to the possibility of cultivating resistant species of chestnut to replace the trees that have succumbed to the attack of *Blepharospora cambivora* in the chestnut woods destroyed by the Ink disease, recourse may be had to the "tambu" variety of *Castanea crenata*, a native of the Far East. A similar measure is adopted in the case of the sugar-cane in Hawaii where no other varieties may be grown but those resistant to "sereh", mosaic and Figi disease; one such variety is "Badila", a cane indigenous to New Guinea, where the latter disease appears to be endemic. The following is a summary of what DUFRENOY and BLIN have said on this subject.

In his attempt to determine the factors inducing the resistance of the chestnut-tree to Ink disease, supposed to be due to *Blepharospora cambivora*, PETRI rejects the hypothesis of there being a chemical difference in the composition of the cell-sap of the Japanese and French chestnut. Although the macrochemical analysis of the cortical parenchyma of *C. crenata* shows the tannin content to be 7.10 % or only a little lower than in the case of our own chestnut,

this is due to the greater amount of bast fibre in the bark of *C. crenata*; this fibre which contains no tannin occupies the place of a certain number of tanniniferous cells. In fact, macrochemical analysis reveals no special difference in the querci-tannic acid, or gallic acid present in the cortical cells of the two varieties of chestnut. Atmospheric oxygen, however, darkens the tannic extract of *C. crenata* more than that of the Italian chestnut.

Blepharospora develops equally well on the wood extract of either variety but the presence of tannin retards its growth which ceases if the percentage of tannin exceeds 0.5.

Blepharospora can also be cultivated on sterile pieces of the wood of *C. crenata* and *C. vesca*.

PETRI inoculated the roots of 4 year-old French and Japanese chestnut-trees with the mycelium of the fungus and found that in both cases the parasite was able to penetrate through the cortex, though the Japanese variety reacts to the infection by the rapid formation of wound-callus, cutting off the diseased zone by means of layers of phellogen. It is to the rapid formation of phellogen that the tree owes its power of resistance.

The discovery in America, of a species of chestnut (*C. dentata*) that is resistant to *Endothia parasitica* has done much to control Chestnut blight and every effort is being made to extend its cultivation. *C. dentata* is, however, severely attacked by *Blepharospora* to which *C. mollissima* alone is resistant; although BLIN is of a contrary opinion, and in his study of resistant species, he mentions both *C. dentata* and *C. mollissima* which have been introduced from Japan and China respectively into France where they have proved to be very satisfactory.

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AGRICULTURAL INTELLIGENCE

AGRONOMY.

Agricultural Meteorology.

329. **The Wheat Climate in Italy.**

AZZI, G. *Nuovi Annali del Ministero per l'Agricoltura*, Year II, No. 3, pp. 453-624, figs. 11. Rome, 1922.

The chief object of this work is to use the existing observations and data relating to wheat development and to the course of meteorological phenomena, for the purpose of discovering in the complex interplay of bio-environmental correlations the main outlines of the meteorological-agricultural wheat problem in the various zones of Italy.

The author, who began as early as 1918, to make a series of parallel observations, at a considerable number of Stations, upon wheat growth and the variations in environmental values, soon became convinced of the necessity to supplement the objective and indiscriminate study of all the different factors by devoting special attention to the local problem of each district as represented by the phenomena exercising a decisive effect upon the results of the harvest.

He also aimed at determining some well-defined principles and hoped to discover therein the clew of Ariadne which should guide him through the maze of the correlations existing between the wheat plant and the climate.

In order to collect the required material the following questionnaire was drawn up:—

1) State in their order of importance the weather conditions injurious to wheat, the frequency of each during a 10-year period. Give, if possible, some information as to the intensity of these meteorological phenomena.

2) What are the meteorological phenomena which although they have no direct injurious effect, yet favour the development of diseases, insects and weeds?

3) Give the varieties of wheat cultivated in the zone, stating in the case of each:

a) the approximate area occupied in % of the area under wheat;

b) whether the said area tends to increase, or decrease, and the causes for these changes;

- c) the behaviour of these varieties as regards inclement weather.
- 4) The dates of sowing, heading and harvesting.
- 5) The altitude limits of wheat cultivation.

The Travelling Schools of Agriculture in Italy, the Agricultural Colleges, Experiment Stations and numerous agriculturists collaborated to insure the success of this enquiry and furnished over four hundred reports that could be used in the work.

The author has divided his work into five parts :

- I) *Regional monographs.*
- II) *Phenoscopic maps.*
- III) *Classification of adverse phenomena.*
- IV) *Classification of the varieties of wheat.*
- V) *General conclusions ; the ecological problem of wheat.*

Regional monographs : Short accounts of the general conditions of the configuration of the zone and the climate ; the distribution, frequency and intensity of the meteorological phenomena injurious to wheat ; the geographical distribution of each variety especially as regards its behaviour under inclement atmospheric conditions. The monographs succeed one another in the following order : Sicily, Sardinia, Calabria, Basilicata, Apulia, Campania, Abruzzi, Latium, Tuscany, Umbria, Marches, Emilia, Venetia and Trentino, Lombardy, Piedmont and Liguria.

At the end of each monograph, a recapitulatory statement is given. The following referring to Sicily is quoted as an instance : —

Varieties	% of area under wheat	Total area in hectares	Yield quintals per hectare	Total quintals
Realforte	25	156 250	8.3	1 299 875
Biancuccia	14	87 500		746 250
Emilia	10	62 500		518 750
Sammantinara	9	56 250		466 875
Coreitta	9	43 750		363 125
Gigante	6	37 500		311 250
Pano	5	31 250		259 375
Scorzonera	5	31 250		259 375
Majorea	5	31 250		259 375
Ruscia	4	25 000		207 500

The chief characteristic of the climate of Sicily from the standpoint of wheat cultivation is the unequal distribution of the rainfall and the differences in the amount of rain from one year to another. It may be said that, on an average, there is a deficiency of rain four times in 10 years, and an excess of rain once during the same period ; such variations have a decided and very injurious effect on the wheat crop.

The drought and the "stretta" (lack of moisture and high temperatures) are the factors most injurious to the satisfactory development of wheat. All the varieties of wheat grown in the island are with few exceptions, highly resistant to drought. The rainfall increases and the tem-

perature decreases in passing from the coast to the interior, so that although drought remains the dominant factor, other adverse phenomena increase in importance, thus necessitating different kinds and types of adaptations. There are therefore 3 zones, the coast, hill, and mountain zone respectively, each possessing its own distinctive varieties of wheat. From *Biancuccia*, *Sammartinara*, *Scorzonera*, *Corcilla* on the coast we proceed to *Realforte* in the hilly land and to *Majorca*, *Castiglione*, etc. in the mountains.

Phenoscopic maps. — In this chapter, are collected, and illustrated by means of small maps, the data relating to the sowings, heading and harvest. The vegetative period is divided into 4 subperiods:

- 1) autumnal: sowing, germination of seed, first growth of seedlings;
- 2) winter: tillering;
- 3) spring: resumption of tillering, heading;
- 4) summer: from heading, to ripening and harvest.

We now know that it is not the absolute value of a meteorological factor that counts, but its distribution during the different stages of the growth period. Thus for instance, the total rainfall throughout the vegetative period in no way explains the relation between the harvest and the amount of rain that has fallen. Indeed, during the subperiod between tillering and heading drought is one of the most injurious factors, whereas in the subperiod from heading to the harvest, excess of rain will certainly have a bad effect. It is thus clear, that with an equal sum of rainfall during the vegetative period, diametrically opposite results may be obtained according to the distribution of the rain. Therefore, if the total amount, of rain for instance, is divided into quantities and fractions corresponding to each subperiod, this will greatly facilitate our search for the correlations existing between rainfall and harvest.

Classification of adverse phenomena. — The author studies for each of the subperiods (autumnal, winter, spring and summer) the "excess" and the "deficiency" of moisture and temperature from the standpoints of wheat development and productivity, he also estimates the frequency of these factors during a 10-year period as well as their intensity and distribution. The following table gives the maximum and minimum thermic and pluviometric limits of the normal development of wheat, as far as it was possible to determine them during the course of these researches.

Limits	Sowing	Tillering	Heading	Flowering and setting	Grain production
Pluviometric, in mm.	max. 200 min. 50	250 100	— 45	80 —	60 —
Thermic, in degrees centigrade	max. — min. —	+ 11 — 5	— + 2	+ 31 + 10	+ 32 + 12

The author uses a double basis of reference in estimating the losses due to bad weather:

- 1) The average harvest for the period 1909-1910.
- 2) The maximum harvest during the same period.

The use of these two bases, instead of a single one which is artificially modified according to the object of the determination, presents considerable advantages from the standpoint of the quicker and better utilisation of the data available for the estimation and assessment of the risk.

1) Reckoning the loss on the basis of the deficiency in a maximum crop gives the real, absolute measure of the effect of the adverse weather conditions, but would make the risk appear too great, for this should be estimated from the average crop, upon which, indeed, is based the valuation of the capital.

2) On the other hand, basing the loss upon the average crop would make it impossible, in many cases, to determine how far bad weather decreases this average value.

In fact, if in certain districts, the rainfall is deficient in 19 years out of 20, which means an average yield of 7 quintals per hectare, and the harvest is so large the twentieth year, that the yield is doubled (14 quintals), the average yield of this year would yet be very low, viz., 7.3 quintals,

$$\frac{(7 \times 19) + 14}{20} = 7.3$$

If the estimation is made on loss due to drought, this would be nothing in years when the deficiency in rain-fall caused the crop to remain at 7.3 quintals, and the effect of the adverse meteorological conditions would thus be underestimated. It would be enough to alter the type of farming by the introduction of irrigation, in order to see at once the *depreciation* in the average crop when it is not irrigated. Indeed, irrigation finds its economic justification in the fact that it causes the complete elimination of drought factor and produces, as far as the water supply is concerned, the maximum yield. It is on this maximum that the variations in the crop should actually be based.

The two bases of reference are thus reciprocally complementary.

Owing to the difficulty in determining the particular effect of each phenomenon, the author has decided to confine himself to two large subdivisions:

- 1) Losses due to excessive moisture and deficient heat;
- 2) Losses due to deficient moisture and excessive heat.

Italy has been divided, according to the amount of these losses, into the following geographical zones:

1) Southern arid zone *Ab*: the losses due to excessive rainfall are here very slight (19 and less per hectare) at least, three times lower than those occasioned by drought.

2) Southern rainy zone *Aa*; here, the excessive rainfall and the low spring temperatures are the adverse factors occupying the second place and causing sometimes about half as much loss as drought. They must be taken into account in selection work (resistance to lodging and rust, as well as drought resistance).

In the zones *B* (*Ba*, *Bb*, *Bc* and *Bd*), the losses occasioned by excessive rain are equal to, or greater than, those due to lack of moisture. The following are the characters of each zone of this group:

3) Zone *Ba*: north arid; after excessive moisture, drought (generally accompanied by "stretta") is the factor ranking second in importance; the intensity of this phenomenon and the injury it causes may be compared in certain localities to the harm occasioned by excessive rain.

4) North zone *Bb*, where "stretta" prevails. After excessive moisture, the most injurious factor here is the "stretta" of heat.

5) Northern zone *Bc*, with fogs. After excessive moisture and a too low temperature, cold fogs during the flowering and setting are the phenomena doing most injury to wheat.

6) Northern cold zone *Bd*. Here, the cold of winter ranks immediately after excessive rainfall and low temperatures as the most injurious phenomenon.

7) Mountainous zone *C*: characterised by violent winds and severe winters.

Although this zone is partly included in the preceding zone, it is clearly distinguished from the latter by a series of special agro-geological and meteorological characters due, not only to its altitude, but to the complexity of its surface configuration which divided the physiological unity of the zones into a series of different types distributed according to the exposure of the slopes, the character of the rocks, and the vegetation.

Classification of the varieties of wheat. — This is not a botanic classification, the varieties being grouped in distinct classes and categories according to their behaviour under adverse weather conditions.

On the other hand, the working up of the meteorological data has already revealed the existence of physiological zones distinguished by their predominant adverse phenomena which form a natural basis for classification.

The author thus proceeds to study each variety zone by zone, giving in each case the behaviour of the variety towards adverse meteorological conditions, its distribution and density in the different parts of the area it occupies.

The following, for instance, is a description of "gentil rosso" (zone *B*).

Resistant to lodging and rust, but susceptible to "stretta" (Parma).

Average resistance to rust and lodging (Ferrara).

Resistant to low temperature (Betlune).

Resistant to lodging, whereas "Cologna" lodges easily (Treviso).

Resistant to drought and lodging (Novi Ligure). It resists winter cold well, but is inferior to "Cologna" as regards resistance to rust and lodging (Bergamo).

Average resistance to lodging, little resistance to cold (Cuneo).

Early-maturing, immune to "stretta", resistant to lodging (Bobbio).

Specific productivity high, resistant to lodging (Fermo).

Thus, "Gentile" is resistant to cold at Belluna — slightly resistant to low temperatures and the snow that covers the ground for a long

period at Cuneo — in fact, at Cuneo, the snow lies longer than at Belluna sometimes lasting until the end of the winter.

As regards temperature, there is no difference between these two places, the lower resistance of "Gentile" recorded at Cuneo, is probably due to the simultaneous negative action of other factors (wind, snow lying on the ground, etc.). The series of minima (Cuneo-Belluna) for the month of February approximately marks the cold limit for the profitable cultivation of "Gentile rosso" in the north.

In short, this variety maintains its position owing to its high specific productivity, its average resistance to all the negative phenomena in zone B in fact, it resists rust and lodging, and penetrates on account of its relative early maturity even into zones subject to "stretta" (Bobbio). Owing to its cold-resistance, "Gentile rosso" extends as far as the Belluna sector, and can even thrive in localities invaded by fogs, or subject to want of rain, provided the deficiency in moisture does not amount to drought.

The data respecting the distribution of this variety in provinces and communes, show that it is the wheat chiefly grown in Tuscany, Emilia, Venetia and Lombardy. It has recently spread at the expense of *Rieti*, *l'Hybride de Vilmorin* (Emilia), *Cologna* (Mantua), *Montano local* (Bobbio), *Carlotta Strampelli*, *Noè* (Rocca S. Casciano), *Calbigia*, *Carpegna* and *Torrechio* wheat (Mercantino Marecchio), *Gentil bianco* (Arezzo), *Mazzocchio* (Campo Lucca), and local varieties (in Trentino).

"Gentil rosso" has also found its way into Latium, Umbria (where it has replaced *Rieti* and *Calbigia*), the Marches, where it tends to supplant *Carosello*, and along the coast while from the Abruzzi, it has succeeded in penetrating into Apulia.

In the "Terra di Lavoro", where it finds really favourable conditions from the agro-geological and meteorological standpoints, "Gentil rosso" is very widely cultivated in the territory of Frignano Maggiore and has penetrated also into the province of Benevento. In the south, the spread of this variety is checked by high temperatures during the grain-setting and by the spring drought.

In the north, it has made its way from the coast to the Province of Port-Maurice and the extreme East and West sectors of the Province of Genoa; while in Piedmont, it continues to spread in the provinces of Turin and Alessandria. Along the boundaries of the distribution area, and even in the interior of the latter, each storm marks out zones showing the average resistance of "Gentil" to adverse factors which increase in intensity so as, at a certain point, to prevent its being cultivated and necessitate the choice of a type of wheat with high powers of resistance. This is the case, in all the wind swept mountain sectors, where low-growing varieties resistant to shelling always give the best results. Thus, *Venachio* does well on the mountains of Garfagnana, the wind wheat (*Calbigia*), thrives in the Apennines of Tuscany and Emilia. In very low, damp localities threatened by rust and floods, such as the low-lying valleys of Tuscany (especially those of "Lucchesia"), Umbria and the Marches, *Rieti* holds its own. In the "Marcite", of "Lomellina", or of "Canavesano" "Gentil rosso" does not prove sufficiently resistant to the damp,

cold and fogs, and has to give way before *Rieti* and *Rosso Canavesano*, while in the territory of Cremona, along the banks of the Po, "*Gentil Rosso*" has still a serious rival in the *Hybride de Vilmorin*.

In the driest parts of the south-west corner of Tuscany, *Cascola* is always the favourite variety, while in the territory of Cuneo, and in the Alpine districts where "*Gentil*" is kept in check by the low temperatures and the long time the snow lies, the predominant varieties are *Piemonte* and *Rosso di Montagna*.

The same details are given by the author in the case of the other varieties of wheat cultivated in Italy.

The following is a list of the varieties showing most resistance to adverse weather conditions, and distinguished for high productivity and the good quality of their grain. The author uses a conventional scale of values ranging from 1 (= maximum susceptibility; low productivity; bad quality of grain) to 20 (= maximum resistance, high yield; excellent grain).

Wheats very resistant to drought: 15-20 *Biancuccia*, *Nurru*, *Arrubiu*, *Biancale*, *Cocitta*, *Rossarda*, *Copinera* (19); *Realforte*, *Trigu canu*, *Trigu biancu*, *Listia niedda* (18); *Duio di Puglia* (17); *Rossia*, *Bianchetta* (16); *Saimmartinara*, *Scorzonera*, *Majorcone*, *Biancolino d'Elba*, *Granone dell'Elba*, *Cascola* (15).

Very early-maturing wheats (15-20): *Rossarda*, *Copinera* (19), *Biancolina d'Elba* (18); *Realforte* (17); *Trigu biancu* (16); *Romanello*, *Cologna* (15).

Very cold-resistant wheats: *Petit rouge de montagne*, *Indigien d'Aoste*, *Locale de Domodossola* (19); *Bon Fermier*, *Gros bleu*, *Saumur*, *Poulard blanc*, *Rosso Piemontese*, *Rossetto* (16); *Venacchio*, *Restajolo*, *Borrecchio* (15).

Wheats very resistant to lodging: *Poulard blanc*, *Inversable* (18); *Noé*, *Rosso Canavesano*, *Rossolona*, *Quattro Corte*, *Civitella*, *Fucense*, *Risciola*, *Biancolino dell'Elba*; *Trigu canu*, *Scorzonera* (15).

Wheats very resistant to rust: *Carlotta Strampelli*, *Rieti*, *Fucense*.

Wheats very resistant to fogs: *Majorcone*, *Rieti*, *Bianco di Napoli*.

Wheats very resistant to wind: *Calbigia bianca* and *Calbigia rossa*.

Wheats of high specific productivity: *Biancuccia*, *Bianco*, *Preziosa*, *Francisca*, *Civitella*, *Gentil rosso*, *Rosso Canavesano*, *Bon Fermier*, *Gros bleu*, *Poulard blanc*, *Granone dell'Elba*.

The following table contains data referring to certain varieties of wheat that are distinguished by a combination of positive characters.

This table allows of an adequate idea being immediately formed as to the good qualities and defects of each variety, further, it is a reliable guide both for the agriculturist desirous of choosing the type of wheat most suitable for his district, and for the plant-breeder who aims at combining in the best proportions, so as to attain the maximum yield, the two characters of inherent productivity and resistance to the most injurious local factors.

The chief object of the author is to point out in this monograph the best ways of extending the study of the correlations between wheat de-

Varieties	Physiographical zone	Loafing	Rust	Low temperatures	Drought	*Stretta*	Wind	Fog	Yield	Quality
Biancuccia	Ab	—	—	—	20	—	—	—	18	18
Rossarda di Capinera	Ab	—	—	—	20	20	—	—	7	15
Trigu canu	Ac	12	12	—	19	10	—	—	—	—
Biancolino dell'Elba	Ac	15	15	—	16	19	—	—	15	—
Fucense	B	15	15	13	—	—	—	15	—	—
Civitella	B	15	12	10	—	12	—	—	20	5
Gentil rosso	B	12	12	10	—	10	—	—	19	19
Quattro corte	—	—	—	—	—	—	—	—	—	—
Rossolone and Rosso cana- vesano	Bd	15	12	13	—	—	—	—	—	—
Poulard blanc	Bd	20	5	17	—	—	—	—	18	—
Inversable	B	20	3	14	—	5	—	—	18	12
Rustajolo	C	13	13	15	—	—	15	—	—	—

velopment and meteorological factors. In addition, the monograph renders it possible to turn to account, every year from the beginning, the results of the parallel observations made on growth and on the variation in environmental values and thereby gradually to improve the classification reached by the author through working up the material supplied in answer to his questionnaire.

G. A.

Pedology.

330. The Mechanical Analysis of Soils.

I. — ROBINSON G. W. (Adviser in Agricultural Chemistry, University College of North Wales, Bangor). Note on the Mechanical Analysis of Humus Soils. *The Journal of Agricultural Science*, Vol. XII, Part. 3, pp. 287-291.

II. IDEM. A New Method for the Mechanical Analysis of Soils and Other Dispersions. *Ibidem*, pp. 306-321, figs. 4.

I. — The mechanical analysis of soils rich in organic matter is difficult, and in the case of peaty soil has only a very limited value. This is chiefly due to the fact that humus acts as a cement upon the soil particles, thus hindering their dispersion. In order to destroy the organic matter various chemicals have been used, such as hypobromide of sodium; boiling nitric acid for diatomaceous earth (fossil flour); hydrochloric acid for soils free from calcium carbonate, etc. There are, however, certain objections to these energetic reagents; thus for instance, the acid dissolves appreciable quantities of clay and other finely divided mineral matter; while alkalis attack the silica and the colloidal silicic acid present in the soil.

The author has made experiments with ammonium persulphate, but this produced a certain amount of sulphuric acid which dissolves the min-

erals of the soil, unless it is neutralised as soon it is formed, and another disadvantage is the necessity to remove the large amount of persulphate of ammonia introduced.

On the whole, however, the results obtained are good, thus in one soil of North Wales, the author found 16 % of organic matter by means of oxidation with ammonium persulphate, keeping the solution nearly neutral, as against 10.5 % found by the hypobromide method, 13.5 % with hydrochloric acid, and 6.9 % by the ordinary method ; without neutralisation 13.04 % would have been determined.

The practical difficulties of this method led the author to try oxygenated water ; the results obtained were still better inasmuch as a high percentage of oxidised organic substances were obtained which differed but little from that determined by ignition and a high degree of dispersion was produced as was proved by the amount of clay (in one analysis 17.9 % as against 6.2 % with the ordinary method ; in another, 17.6 % as against 6.3 % etc.). The author ascertained that the strong dispersion action was not apparent, the viscosity having been reduced as a result of the oxidation, in fact viscosi-metric tests proved the viscosity not to have been appreciably altered. The clay formed in this way, unlike that separated by the ordinary method, showed silky reflexes (caused by microscopic mineral crystals) when suspended in water. These will form the subject of a later enquiry.

The technique employed was as follows : 10 gm. of soil were placed in a beaker having a capacity of 600-700 cc., 50 cc. of water oxygenated to 20 volumes were then introduced and the beaker was placed over a bath of boiling water ; a violent reaction then took place. The mixture was stirred from time to time ; after 30 minutes, the reaction ceased ; 25 cc. more water were added, care being taken to detach, by means of a jet of water, any particles of soil still adhering to the sides of the vessel. After heating for another 15-20 minutes the reaction is generally finished (only in the case of a soil that is very rich in organic matter would it be necessary to add more oxygenated water), 100 cc. of distilled water are then added and the mixture is boiled for 15 minutes, after which the mechanical analysis is carried out in the usual manner.

II. — Graphic charts are generally used in the ordinary methods unless the fractions are few ; the number of fractions can be increased, but only at the expense of the accuracy of the determinations.

Accurate methods of graphic representation have been devised. OPEN registers by means of an automatic apparatus that raises the deposit at given intervals of time, but the apparatus is costly, difficult to handle and cannot be continuously used. WEIGNER has devised a modified and simpler apparatus of the same type, which consists of a U-tube with a very thin communicating portion. One arm contains the suspension, and the other pure water. Owing to the difference in specific gravity, the column of water rises higher than the other, but sinks as the sediment is deposited. from the suspension, and the level of the water column is read and registered. The great disadvantage of this method is the very long time required, in fact the two columns must be about 1 m. high in order for it to be pos-

sible to register the differences in the level of the water, and as sedimentation takes place slowly through a water column of this height, the average time taken with the apparatus is 24 hours.

The author has considered another method based on the different velocity of sedimentation of soil particles of various sizes. He starts from the premise that one particle does not carry others with it as it falls. This method is explained by the graph (Fig. 78) where the upper part $ABCD$ represents the material suspended in a column of liquid of the height AC . Each vertical line $a, b \dots k$, corresponds to a column of suspended material of different dimensions.

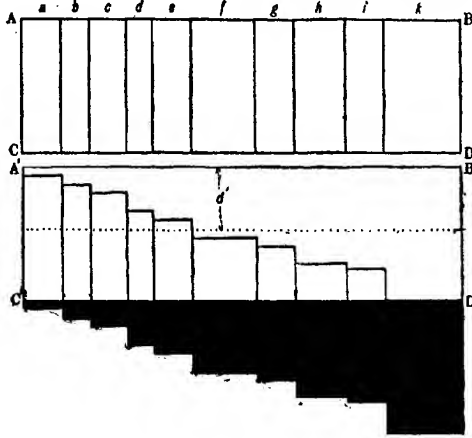


Fig. 78. — Diagrammatic representation of the sedimentation.

The size of the particles increases from a to k ; thus for instance, a represents clay, and k represents fine gravel. In the lower rectangle $A'B'C'D'$ the lines represent the amount of the materials that has remained in suspension for a certain time, t , the black area below the line $C'D'$ measures the thickness of the deposit.

In the case of each column, the sum of the suspended part and of the deposited part gives the original height.

If at this time, a little of the suspended material is taken at the depth d' , the only particles found will be those ranging in size from a to e whose velocity in falling is less than d'/t ; the liquid will not contain a single particle of the larger sizes f to k , whose velocity in falling is greater than d'/t . On determining the concentration for the different values of d'/t , it is possible to draw a graph, which will show the percentage of the substances of varying size held in suspension in the liquid, and thus the composition of the soil.

In practice it is sufficient to place the suspension in a calibrated cylinder, to take small samples at a given depth and at fixed intervals of time, and to measure the percentage of solid substances contained in each sample. These figures are then transferred on to a system of coordinates, where the abscissae correspond to the percentages of the solid substances, and the ordinates to the time, or better to the falling velocity, or better still to the logarithms of these velocities.

The following is an example: in the graph (Fig. 79) the ordinates 5-3 are: logarithms of the velocities expressed in centimetres to the second power: thus to log. 5 there corresponds a velocity of 0.00001 to the second power, etc. The ordinates A-F (shown by lines at given distances) correspond to the falling velocities of known substances: clay, fine sand, etc. The abscissae measure the percentages of substances corresponding to the different falling velocities. Each ordinate represents the average

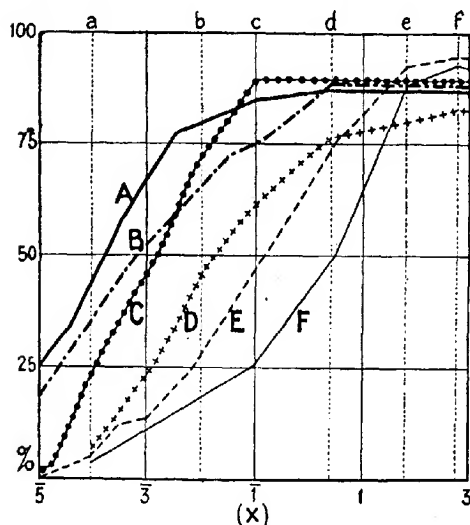


Fig. 79. Composition of typical soils.
Abscissae: logarithms of the velocities.
Ordinates: percentages.

- A = Langold clay.
- B = London clay.
- C = Kaolin.
- D = Alluvium.
- E = Gravel.
- F = Sandy clay.

of the present and the preceding determinations added together: if this were not so, in view of the varying nature of the composition of the soil, the construction of the graph would be impossible. Thus the kaolin submitted to experiment contains about 40 % of particles with a falling velocity lower than log. 3, about 1.87 % with a falling velocity lower than log. 1, and no particle of greater velocity.

This method is much quicker than the usual one, it admits of six analyses being made for each apparatus per day, and it is more economical, in so far as it does away with the use of sieves, filters, ovens, distilled water

and reagents: it is more exact, as it admits of graphic representation, which is far clearer than lists of figures. It has the further advantage that absolute accuracy is required in the investigations: an error of 1 mg. in weighing is enough to introduce an error of 9.25 % in the results. It is advisable to note, that high temperatures, due for example to the presence of stoves or radiators, must be avoided: an enquiry will have to be made later into the influence of temperature.

L. V.

331. **Some Investigations on the Electrical Method of Soil Moisture Determination.**

DEIGHTON, T. (School of Agriculture, Cambridge). *The Journal of Agricultural Science*, Vol. XII, Part 3, pp. 207-230, figs. 6, bibliography. Cambridge, 1922.

The author has measured electric conductivity *in situ*: the electrodes used were the carbon-points of electric arc-lamps. These carbon-points, which were 2 inches long and $\frac{3}{4}$ inch thick, were completely isolated except along a strip 1 inch in breadth near the paraboloid end. On burying the electrodes to a depth of 7 inches at a distance of 3 inches apart, the author was able, by means of many determinations, to trace the line of iso-resistance in a small plot of ground.

Electric resistance is connected not only with moisture, but also with other factors, such as the presence of electrolytes, and especially of nitrates.

From his observations of various substances in suspension, the author found differences in their behaviour when the amount of moisture was the same; this proves the influence of other factors, although in every case, there was a certain connection between the moisture and the electrical resistance; thus the resistance increases in inverse proportion to the square of the moisture if the moisture percentage is above 10%, if it is lower, peaks occur in the logarithmic curves in the two opposite directions according to whether the matter in suspension contains colloidal substances, or not. The time factor also has an effect upon the results obtained.

The author refers to the work of other investigators on the same subject. L. V.

332. **The Practical Measurement of Soil Acidity,**

HISSINK, D. J. Dr. Eenige opmerkingen over de beteekenis van het schatten van den zuurgrad van den grond door en voor de practyk. *De Veldbode*, No. 1066, pp. 475-476. Maastricht, June 1923.

The author, who is the Director of the Experiment Station of Groningen (Holland), has so far distributed to agriculturists, 250 "Comber" instruments for measuring soil acidity. The figures obtained with this instrument are not absolutely accurate, but serve for practical purposes, indeed, the measurements made by agriculturists and tested by the author in his laboratory have in several cases proved to be quite exact.

The object of the author in thus distributing the "Comber" apparatus was to obtain a large amount of statistical material. He wished to learn the differences in the reaction of the soil of the same plot according as to whether the plants were growing vigorously or less strongly, since this would show the correlation existing between the degree of soil acidity and crop growth, as well as the amount of acidity required in the case of a given type of soil in order to insure the maximum development of any particular cultivated crop. It is also necessary in this connection, to

take into account the situation of the fields, the fertiliser used, and the drainage.

The author gives an answer to the question put by many agriculturists who wished to know whether it was possible to determine by the Comber apparatus the amount of lime required for neutralising acid soils. The quantity of lime to be applied to acid soils depends, not only upon the degree of their acidity, but is also influenced by the amount of clay and humic substances present. In order to obtain accurate data, the author advises that the soil samples should be analysed in the laboratory.

The Comber method has, however, the advantage of enabling the agriculturist to know how many samples should be sent to the laboratory, which allows of the number being reduced and saves expense.

The author advises the regular testing of soil reaction, even after neutralisation, for it is always possible that some of the lime, or of the chemical fertilisers, may have been removed by water, or that their action may only be evident after several years.

By means of the Comber method (1) the agriculturist will always be able to decide for himself whether sulphate of ammonia is better for the soil than nitrate of soda and whether superphosphates or basic slag is the most suitable fertiliser in any given case

D. V. S.

333. Microbiological Analysis as an Index of Soil Fertility.

I. — WAKEMAN SELMAN, A. The Influence of Reaction upon the Growth of Actinomycetes. *Soil Science*, Vol. XIV, No. 1, pp. 61-80. Baltimore, Md., 1922.

(1) The Comber method is described by the author in the *Journal of Agricultural Science*, 1920, p. 420. About 5 cc. of a colourless solution of 40 gm. of sulphocyanide of potassium in a litre of 95 % alcohol are introduced into a test-tube containing 2.3 gm. of soil. The test-tube is then corked and well shaken several times. As soon as the material in suspension has been deposited, the acidity as determined from the colour of the liquid.

Reaction	pH	Colour
Very acid	4-5	dark-red
Acid	about 5	red
Slightly acid	5-6	light-red
Very slightly acid	6-6.5	pale pink, or colourless
Traces of acid	6.5-7	Always colourless
Neutral	7	
Alkaline	above 7-6.5	

If the liquid remains colourless, some chloride of iron is added to colour the solution which is left for 18-24 hours and again shaken. If all the red coloration has disappeared, the soil will be about neutral (pH = 7); if however, the red tint is still clearly visible, the reaction will be slightly acid. In order to estimate the alkalinity, a series of solutions coloured with increasing amounts of chloride of iron are prepared. The more alkaline the soil, the more iron chloride it is able to absorb. (Ed.)

II. — *IDEM*. Microbiological Analysis of Soil as an Index of Soil Fertility: 1) Mathematical Interpretation of Results Obtained from Bacteriological Analysis of the Soil. *Ibidem*, pp. 81-101; 2) Methods of Study of Numbers of Microorganisms in the Soil. *Ibidem*, No. 3, pp. 283-298. 3) Influence of Fertilisation upon Numbers of Microorganisms in the Soil. *Ibidem*.

The author in the first paper reaches the following conclusions:

1) Results based upon a single soil sample are of no value. Several samples of the same soil (mixed if possible) should be used.

2) A sufficient number of plates must be employed (8-10 for each soil sample), in order that the most probable average error in calculating the number of microorganisms in each soil may be below 5%.

3) The number of bacteria and of actinomycetes alone should be determined by means of normal plates; for the estimation of hyphomycetes, it is necessary to employ special acids ($P^m = 4.0$) with dilutions $1/100$ of those used in estimating the total number of microorganisms.

4) It is necessary to have recourse to synthetic methods. The plates should be inoculated for 7 days at 27° - 28° C., or for 14 days at the temperature of the surrounding air, and all the colonies ought to be counted on each plate, the optimum being 50-200 colonies of microorganisms per plate. The only plates to be discarded are those with much growth of moulds.

5) By adopting these precautions, it was found that the application of fertilisers to a sandy soil not very rich in organic matter produced the following results:

a) Salts of potassium and phosphates stimulated the development of microorganisms, their effect being greater in the presence than in the absence of lime.

c) Nitrate of soda stimulated the development of the bacteria and actinomycetes, but not that of the hyphomycetes.

d) Sulphate of ammonia, by making the soil distinctly acid, stimulated the development of the hyphomycetes, but produced a decided decrease in the number of the bacteria, and especially in that of the actinomycetes. When lime was added to the ammonium sulphate, the stimulating effect was equal to that shown by nitrate of soda.

e) Stable-manure has a distinctly stimulating effect on all the groups of microorganisms that developed on the plate.

6) Production in the respective soils was almost parallel with the number of microorganisms present.

The number of microorganisms in a soil, when determined under proper conditions, the variability of the method and soil being taken into account, may serve as a means of determining the bacteriological conditions and the fertility of the soil. G. R.

334. *Microflora of the Polar Regions.*

BARTHEL, C. Recherches bacteriologiques sur le Sol et sur les Matières fécales des animaux polaires du Groenland septentrional. *Den II. Thule Ekspedition til Grønland Nordkyst*, 1916-18, No. 1. København, 1922.

Very few books have been written on the bacterial flora of the polar regions, and two alone (which refer solely to the Antarctic) deal with the

microbiology of the soil. To these latter must now be added the author's work which describes his researches on soil samples taken by Dr. Thorild WULFF on the Island of Disko, in the neighbourhood of Cape York, and during the second expedition of the "Thule" to the north coast of Greenland in 1917, conducted by Knud RASMUSSEN, that is to say, from completely unknown, virgin land.

The soil samples examined were 18 in number; of these 14 came from the Island of Disko and had been kept for 50 days, while 2 came from the region of Cape York, and 2 from the north coast of Greenland; they had been kept for about a year (at 45° C. below zero like the others). There were 8 samples of faeces, 5 from Cape York and 3 from the north coast of Greenland; all of these had been kept for about one year. The animals to which they belonged were blue fox, Polar wolf, crow, seal, white bear, lemming, white partridge and *ovibos*.

From the Disko and North Greenland soil samples 19 species of bacteria were isolated, 2 of which could not be identified. The identified species are a *Tetracoccus*, *Sarcina flava*, *Bact. fluorescens*, *Bact. punctatum*, *Bact. lactis viscosum*, *Bact. violaceum*, *Bact. caudatum*, *Bact. umbilicatum*, *Bact. ochraceum*, *Bact. Zopfii*, *Bact. subtilis*, *Bact. mesentericus*, *Bact. malabarensis*, *Bact. asteriosporus*, *Bact. amylobacter*, *Bact. saccharobutyricus immobilis*, *Bact. putrificus*. In addition, some species were determined of the genera *Torula*, *Actinomyces*, *Oidium*, *Dematium* as well as of hyphomycetes.

Nitrate of potassium was found in almost all the soils and the presence of a living nitrifying organism in addition to that of denitrifying, ammonifying and uric bacteria was demonstrated. The almost constant occurrence of butyric ferments and of *B. asteriosporus* and *B. malabarensis* makes it most probable that these soils have the power of fixing nitrogen.

The faecal matter evacuated by Polar animals always contains different species of schizomycetes, *torulae*, actinomycetes and moulds. The author succeeded in isolating 20 of these organisms which have been identified as follows: *Micrococcus pyogenes albus*, *Micr. candidans*, *Micr. E.* (Barthel) *Sarcina flava*, *Streptococcus liquefaciens*, *Str. faecium*, *Str. bovis*, *Bact. subflavum*, *Bact. Pasteuri*, *Bact. subtilis*, *Bact. putrificus*, *Bact. saccharobutyricus immobilis*.

In the opinion of the author, the chief result of this work is that it gives proof of the ubiquity of the common bacteria of the soil and of those in the large intestine of warm-blooded animals which would seem to show that both on the north coast of Greenland, and in the European countries, organic matter is transformed by the same species of bacteria. G. R.

Fertilisers and Manures.

335. A Study of certain Preservatives and their Effect on the Fertilising Value of Manure.

COLLISON R. C., and CONN, H. J. New York Experimental Station, *Bulletin* No. 494, pp. 28-74, figs. 21, pl. 6. Geneva, N. Y., 1922.

The value of manures produced on the farm has increased to such an extent that every precaution should be taken to conserve the contained

plant food-material. The authors have carried out a large number of experiments in order to study practical methods of treating manure so as to retain the plant food constituents. In the past, both mechanical and chemical methods have been recommended such as storing under cover and trampling down, or the addition of other materials, with a view to the prevention of loss of nitrogen caused by fermentation in the manure heap, or by leaching. Mechanical methods often necessitate extra labour and under ordinary conditions of farming it is usual to store manure for several months, hence, preservation by means of chemical agents assumes importance. An ideal chemical substance should prevent undesirable fermentative changes, but should not check the changes which break down the manurial compounds and make them available as plant food. If in addition, the added substance has a fertilising value of its own it is an advantage, provided that the cost is not too great. The authors experimented with the following materials: straw, peat, a clay-loam-soil, acid phosphate, rock phosphate and gypsum, and investigations were carried out with these materials under both laboratory and greenhouse conditions.

Allusion is made to the work of SEVERIN and of RUSSELL and RICHARDS and to the fact that the latter investigators found that the nitrogen losses were due to the volatilisation of elementary nitrogen, rather than to that of ammonia. SEVERIN isolated organisms from manure and used them to inoculate sterilised manure. The authors searched particularly for the organism concerned chiefly with the volatilisation of ammonia, and succeeded in isolating an organism *Bacterium parvulum* which reduces nitrate to nitrite and causes the evolution of large quantities of ammonia from manure. The laboratory experiments showed that loss of ammonia from manure may be prevented by the use of acid phosphate, peat or gypsum; for instance, the sterilised check lost only 3 mg. nitrogen as ammonia; the unsterilised manure gave off 247 mg.; when gypsum was added only 44.5 mg. were given off, and with peat only 10 mg. or very slightly more than the sterilised check. In this experiment no attention was paid to the loss of free nitrogen. It was shown that preservatives have an effect upon the kinds of micro-organisms present and may suppress those which cause ammonia volatilisation. The results obtained when straw was added to manure were interesting, as they suggest that nitrification may take place in manure.

Laboratory tests in themselves are insufficient, as the real test of a preservative is its ultimate effect on the fertilising effect of the manure, and for this reason compost experiments in the greenhouse were carried out.

For the greenhouse work manure was mixed with the preservatives and kept in a fairly moist condition under cover for three months or more. The composts were then used as sources of nitrogen for crops grown in sand cultures and in the greenhouse, other food elements being supplied by the addition of a mineral nutrient solution. The plants were harvested when the various cultures had reached about the same degree of maturity.

The data relative to these cultures are given below.

*Dry weight of tops and comparative tillering in barley cultures
in compost experiment No. 1, Culture Series No. 1.*

Source of nitrogen	Culture Number	Number of heads	Dry weight of tops
			Grams
Rotted manure	1	10	5.0
Rotted manure + NaNO ₃	2	26	60.5
Fresh manure	3	12	30.0
Fresh manure + NaNO ₃	4	33	61.0
Gypsum compost	5	12	8.5
Gypsum compost + NaNO ₃	6	22	58.5
Rotted manure + gypsum	7	11	5.5
Rotted manure + gypsum + NaNO ₃	8	25	63.5
Acid phosphate compost	9	9	10.5
Acid phosphate + compost + NaNO ₃	10	27	64.5
Rotted manure + acid phosphate	11	10	10.5
Rotted manure + acid phosphate + NaNO ₃	12	29	64.0
Rock phosphate compost	13	11	7.5
Rock phosphate compost + NaNO ₃	14	26	61.0
Rotted manure + rock phosphate	15	11	6.0
Rotted manure + rock phosphate + NaNO ₃	16	28	59.0
Peat compost	17	12	16.0
Peat compost + NaNO ₃	18	34	69.5
Rotted manure + peat	19	11	8.5
Rotted manure + peat + NaNO ₃	20	27	69.5
Straw compost	21	12	9.5
Straw compost + NaNO ₃	22	33	62.5
Rotted manure + straw	23	8	2.5
Rotted manure + straw + NaNO ₃	24	32	64.0
Soil compost	25	11	11.0
Soil compost + NaNO ₃	26	19	36.5
Rotted manure + soil	27	12	7.0
Rotted manure + soil + NaNO ₃	28	24	52.5

A second series of cultures were carried out in soil instead of sand, and a third series with composts, but containing four times the amount of compost used in Series 1 and 2.

Fresh manure gave a higher yield of barley dry tops than rotted manure or any compost, although the peat compost compared favorably. The addition of straw depressed the yield in every case except that of the manure-acid-phosphate-straw compost. When added to rotted manure the depression was 91 %, and it reached 58 % in the manure-peat compost ; further experiments are being made on this problem. In the vegetative experiments, acid phosphate composts gave the greatest weight of tops. Acid phosphate and peat both helped to retain inorganic nitrogen and apparently left the organic nitrogen in a condition more available to plants. The loss of dry matter on composts kept for four months ranged from 25 % on manure treated with acid phosphate to 63 % in untreated manure. Peat also was very efficient. Neither rock phosphate nor gypsum were satisfactory preservatives. The results of these experiments show that

both acid phosphate and peat may be recommended as preservatives of manure. The former involves least labour, but peat has the additional advantage that it is an excellent absorbent of the liquid portion of manure and in consequence acts both as a litter and a preservative. W. S. G.

336. An Ammonia Volatilising Organism found in Manure.

CONN, H. J. (Chief in Research on Soil Bacteriology). *New York Agricultural Experiment Station, Bulletin* No. 494, pp. 26-27. Geneva, N. Y., 1922.

The author in his investigations on bacteria involved in the ammonification of manure, found an organism, *Bacterium parvulum*, which seems to be a hitherto unknown form. The organism gives off from manure in pure culture and under laboratory conditions, amounts of ammonia equal to, or greater than, those obtained from unsterilised manure.

Bact. parvulum is a small, non sporing, Gram-negative rod, which does not liquify gelatin nor ferment sugars, but reduces nitrate to nitrite. It is strictly aerobic with an optimum growth temperature of about 25° C. Punctiform colonies are formed on gelatin, but the growth is small in liquid media.

The author's experiments are of interest in showing that a non-liquifying organism may be responsible for the volatilisation of large amounts of ammonia from manure, and that sterile manure inoculated with this organism may lose more nitrogen as ammonia than the same manure unsterilised.

W. S. G.

337. Fertilising Value of Tapioca Refuse.

GEORGI, C. D. V. *The Malayan Agricultural Journal*, Vol. X, No. 8, p. 218. Kuala Lumpur, 1922.

An enquiry has been made as to the utilisation of refuse from tapioca factories as a fertiliser. This refuse is a greyish white powder containing a proportion of short fibres; the results of analysis are as follows: moisture 11.6; ash 28.7; organic and volatile matter (by difference) 59.7; nitrogen 0.61; potash 0.58; phosphoric acid 0.56%. Although this refuse would not pay for cost of transport, it could however be utilised to advantage *in situ*.

M. L. Y.

338. The Composition of Kedah and Perlis Phosphates.

GREENSTREET, V. R. *Malayan Agricultural Journal*, Vol. XI, No. 3, pp. 70-71, Kuala Lumpur, 1923.

The article gives a description and also the analyses of a number of samples of phosphates received during the past two years. A study of the analyses shows that these phosphates vary greatly in their composition. The phosphoric acid content in Kedah phosphates varies from 12 to 31% and that of Perlis phosphates from 7 to 19%. The acid is combined with aluminium and iron, largely in the form of Wavellite (hy-

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drated aluminium phosphate). One sample of Perlis phosphate contained a large excess of lime, whereas in all the other samples aluminium and iron predominated.

W. S. G.

339. The Constitution of Basic Slag.

SCOTT, A. and MCARTHUR, D. N. *Journal of the West of Scotland Iron and Steel Institute*, pp. 102-figs. 24, bibliography, Glasgow, 1922.

The work of the authors is a noteworthy contribution to the subject of Basic Slag and its constitution, and affords valuable information respecting phosphates. The paper contains the results of microscopic and chemical examinations of slags from both open hearth and Bessemer furnaces. A summary and brief description of previous literature is given, followed by the microscopic characters of the various slags examined and a discussion on the constituents and structures of the particular slags in relation to their chemical analyses. Twenty four reproductions from microscope slides are included.

Each slag was examined by reflected light from the ground and polished surface of specimens, also, thin sections were prepared and studied by transmitted light, while in some cases finely ground material was similarly investigated. The study of the structure of slags is difficult owing to their varied composition and the many forms of calcium and magnesium silicates, but the authors have collated much valuable information on the subject, which will be of great use to future investigators. W. S. G.

340. The Effect of Potassic Fertilisers upon the Development and Chemical Composition of different Cultivated Plants.

E. GODLEWSKI (Chef de division de chimie agricole at the State Institute of Rural Economy of Pulawy (Poland). *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IX, No. 14, pp. 404-412. Paris, 1923.

The soil of the Experiment Station of Cracow University being very deficient in assimilable potash led to the study of the effect of potash on the growth and chemical composition of different plants. The species used were as follows: garden bean, oats, potatoes, peas, mangels, lupin, ornithopus (Serradella), barley, rye and wheat. These plants were grown for several years on the same plots and also in rotation. From his experiments and the analyses made, the author draws the following principal conclusions.

The dry matter of plants growing on a soil poor in potash contains a lower percentage of potash and a higher percentage of other nutrient substances than that of plants taken from a soil possessing a high potash content.

The differences in the composition of the seeds are slight, but the straw composition varies greatly. The effect of an abundance, or lack, of potash in the soil is more marked upon the seed composition of oats and garden-beans than upon that of the other cereals or leguminosae. Deficiency of potash produces scarcely any change in the normal lime and magnesium content of the seeds.

The amount of assimilable potash in the soil is, however, very clearly seen by the straw composition of all cereals and legumes. The potash content may range from 0.5 to 2 % of the dry matter.

A lack of assimilable potash in the soil induces a great change in the proportion $K_2O : CaO : MgO$ in the dry matter of the straw. This proportion varies from 100 : (55 to 120) : (16 to 37) and in the case of a high potash content : 100 : (23 to 28) : (7 to 9). The differences between the straw composition of various cereals are not great. The percentage of lime and magnesium present in legume straw is double that found in cereal straw. The differences due to want of potash in the soil are more marked in the case of legumes than in that of cereals.

Want of potash in the soil is also shown in kitchen-garden plants by the chemical composition of the dry matter of the reserve organs and of the leaves. A decrease in potash is accompanied by an increase in the other nutritive substances. Potato tubers are a remarkable exception as regards their magnesium content, but the amount of nitrogen they contain increases with the decrease in potash.

In the author's experiments, the bean, beetroot, potato and pea were the plants acting most upon the potassic fertiliser. Of the cereals, barley and wheat reacted more strongly than rye and oats. When a plant is cultivated on the same plot, its reaction on the potassic fertiliser is greater than when it is grown in rotation.

The same plant does not obtain the same advantage from the potassic fertiliser every year.

The unequal reaction of various plants upon the potassic fertiliser may be due to three causes.

- 1) Different plants under normal conditions assimilate different amounts of potash. Kitchen garden plants assimilate much more of this substance than cereals and legumes.

- 2) Different plants have an unequal power of absorbing the slightly soluble form of potash present in the minerals of arable soil. The greatest power of absorbing potash is found in mangels grown in rotation, and the lowest in garden-beans.

- 3) Different plants do not utilise potash to the same extent in the formation of organic matter. Kitchen-garden plants produce less organic matter with a given amount of potash than legumes and cereals. Therefore, although they have a great capacity for potash assimilation, kitchen-garden plants require a much greater quantity of potash. Rye uses little potassic fertiliser partly because it has a great power of absorbing slightly soluble potash. When there is a deficiency of available potash in the soil, the other nutritive elements absorbed by the plants are used in a less economical manner than when the plants have an abundant supply of potash at their disposal, so that sometimes a smaller crop will absorb the same, or a greater, amount of nutritive substances than a larger crop grown on a soil rich in potash.

D. V. S.

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341. Composition and Fertilising Value of Wood Ash and other Ashes.

BLACKSHAW, G. N. (Chief Chemist, Department of Agriculture, Rhodesia). *Bulletin No. 447*, pp. 1-4. Salisbury, Rhodesia, 1923.

In countries where, owing to cost of transport, it is not possible to purchase potash fertilisers a valuable substitute may be found in wood and other ashes. The author gives the analyses of several ashes, *e. g.*

Sunflower ash, from the stalks, leaves and heads of sunflowers after removal of the seed: potash 20.9 %, phosphoric oxide 0.98, lime 12.0.
Veldt Hay ash; potash 0.86 %, phosphoric oxide 0.85, lime 2.68.

Attention is drawn to the necessity to protect the ash from exposure to rain, owing to the solubility of the potash, also to the different fertilising value of plant ashes, as shown by the above examples. W. S. G.

Agricultural Botany.

342. Plants of Economic Value introduced into Egypt.

FORBES, R. *Sultanic Agricultural Society, Technical Section, Bulletin No. 10*, pp. 1-64. Cairo, 1923.

Out of about 800 plants introduced into Egypt, chiefly from South West U. S. during the last four years, some 20 have proved of especial economic value, although several others of less importance have readily adapted themselves to the new conditions.

The author states that in many cases standard Egyptian varieties and European importations have been grown in comparison with American introductions, and individual plants are described with sufficient detail to afford an understanding of the comparative merits of the varieties tried.

The twenty cultural successes of more or less economic value include:—

1) *Alfalfa, Hairy Peruvian* (From Arizona). It appears that this variety produces a greater weight of forage than the native "ber-sim hegazi".

2) *Common Arizona Barley*. Very rust resistant and superior to the Wisconsin Pedigreed No. 6 (Arizona) liable to rust etc.; yield of grain equal to Egyptian varieties on good land; superior straw yield; later than the native variety.

3) Beans: *Moki White* Lima bean — well suited to a wide range of climatic and soil conditions, and to several crop rotations; very drought resistant and sets seed readily under arid conditions; of value in dry farming; immune to rust and insect pests.

Red Moki Limas (No. 50) sets its seed under more arid climatic conditions than other varieties.

Kidney beans (*Phaseolus vulgaris*); the Lady Washington and Colorado Pinto, the latter employed as a dry-farming crop in South-Western U. S. A., show adaptation to arid climatic conditions in Upper Egypt. None of the introduced varieties were found rust resistant, and compare unfavourably with already established varieties.

4) Cabbage. American market cabbages are small-headed compared with the native variety, but have given good results owing to the fact that they do not sprout with the advent of the hot weather and consequently are found on the market later.

According to the 1920-21 report, the Danish Ballhead and Winningstadt varieties weighed the most.

5) Cauliflower. Produced seed readily under Egyptian conditions and equal in weight to native variety (Vars. Dry Weather, Autumn Giant and Early Snowball).

6) Chili (*Capsicum annum*). The Anaheim variety has done especially well.

7) Cowpeas (*Vigna sinensis*; *V. Catjang*). The "Blackeye" although liable to rust, produces a seed crop of superior appearance and "New Era" proved rust resistant and a very productive early variety. Both these varieties are considered preferable to the native type.

8) Darso (*Sorghum*) has an advantage over the millets commonly grown in Upper Egypt, as it makes a second growth of heads for forage after the heads are cut.

9) Lettuce. *New York Market* proved the best of 10 introduced American varieties; compact heads of excellent flavour; superior in yield and quality to native varieties but liable to deteriorate rapidly under Egyptian conditions, consequently necessary to import seed each year.

10) Maize varieties: — White Rice Popcorn (*Zea everta*) and Papago Sweet Corn (*Zea saccharata*) have given satisfactory results. Out of 52 varieties of field maize from Australia, South Africa and United States, choice has been made during two years of culture, of 8 most promising varieties for final trial. — viz. North Dakota White, Silver King, Gurney's Model Dent, Silvermine, Italian, Boone County White, Reid's Yellow Dent, Sacaton June.

11) Oats — *Texas Red* rust resistant and good yield of grain to straw, matures later and somewhat inferior yield to native crop.

12) Gourds. — Summer squashes (*Cucurbita maxima*) compared well with pumpkin trials.

13) *Sesbania macrocarpa*, quick growing annual of distinct value as green manure, not successful as a fibre.

Swedish Hairy Winter Vetch (*Vicia villosa*) — possibilities as a cover crop and soil binder — a spontaneous tuberculous species.

Tepary Beans (*Phaseolus acutifolius* var. *acutifolius*) (from S. Arizona and N. W. Mexico). Well adapted to arid climate and will set seed under conditions too hot and dry for ordinary kidney beans — possible value as cover, forage and green manure in Upper Egypt and the Sudan.

Tomatoes. The "Earliana" variety from U. S. A. proved the best out of 30 introduced varieties and is distinctly superior to the native variety, as regards smoothness, percentage of flesh to fruit, appearance, etc. It should replace other varieties in Egyptian markets.

The author gives details concerning several cultural successes of little apparent economic value, and also of decided failures due to lack

of acclimatisation, etc. The latter include. — cantaloupes, cassavas, cucumbers, pumpkins, water melons, peanuts, Swedish gore tares (*Vicia sativa*), and American wheats (unable to withstand rust attack):

A comparison of climatic conditions in Egypt and Southwest U. S. is made and results generally indicate the reaction of differences of humidity, temperature, insolation, character of soil, etc. upon an introduced plant.

M. L. Y.

343. Synopsis of the Species of the Genus *Morus*.

KOIDZUMI, G. Synopsis Specierum Generis Mori. *Bulletin of the Imperial Sericultural Experiment Station Japan*, Vol. II, No. 1, pp. 1-45, plates XI, Tokyo, 1923.

The Monograph on the genus *Morus* by Ed. BUREAU, published, in 1873 (Vol. XVII of Alph. De CANDOLLE'S "Prodromus Systematis Naturalis Regni Vegetabilis" was generally accepted and followed for some 40 years and almost all the forms of mulberries were erroneously treated by Japanese botanists, being referred to as "*Morus alba* Linn. and *M. indica* Linn.

A study of a large collection of mulberries at the Japanese Imperial Sericulture Experimental Station, Tokyo, has led the author to present a different interpretation of some of the forms, introducing radical changes in the nomenclature of the most common Japanese forms, and modifications in the classification of others. In 1917 these alterations were embodied in an article published by the author in the *Tokyo Botanical Magazine*, Vol. XXXI, pp. 35-41, entitled "the Enumeration of all the Known Species of the genus *Morus*", and also in the "Sangio-Shikengo Hokoku" (*Bulletin of the Sericultural Experiment Station*), Vol. III, No. 1, 1917, dealing with the "Taxonomy and Phytogeography of the genus *Morus* Linn.". The present paper is an enlargement of the section on the taxonomy of mulberries and consists mainly of a description and illustrations of the species known to the author as occurring wild or cultivated in Japan, Sachalin, Formosa, Korea and in the Loochoo Islands.

The species are divided into two Sections:

- 1) Dolichostylæ (Style elongated and distinct).
- 2) Macromorus (without style, 2 stigmas, sessile).

The first section includes: *Morus arabica*, Koidz. *M. mongolica* C. K. Schneider, with var. *diabolica* Koidz and var. *vestita*, Rehder.; *M. nigrifolmis* Koidz.; *M. notabilis* C. K. Schn., *M. bombycis*, Koidz.; with var. *caudatifolia* Koidz var. *humilis* Koidz. new var. *aphananthoides*, Koidz.; s. var. *declinata* Koidz var. *lanceifolia* Koidz. var. *vestita*. Koidz. var. *squarrosodentata*. Koidz and var. *maritima* Koidz.; *M. rotundilob* Koidz.; *M. acidosa*, Griffith and var. *glabra* and *M. Kagayamae*, Koidz.

Section II includes: — « *serrata* Roxb.; *M. nigra* Linn.; *M. tiliaefolia* Makino; *M. cathayana* Hemsl.; *M. mesozygia* Stapf. *M. laevigata* Wall.; *M. insignis* Bur. *M. macroura* Miq.; *M. rubra* Linn.; *M. mollis* Rusby; *M. cellidifolia* Kuntz.; *M. boninensis*, Koidz.; *M. microphylla*, Buekl.; *M. multicaulis* Perr. with var. *planifolia* Sering.; *M. alba* Linn.

with var. *pendula* Dippel and var. *argutidens*, Koidz.; *M. atropurpurea*, Roxb. A full botanical description is given of each species in Latin, followed by a list of 31 additional species and considered as synonymous with other species, indicated in each case; a list of 5 doubtful species: *M. australis* Poirét; *M. Cavalieri* Leveillé; *M. insularis*, Sprengel, *M. integrifolia*, Leveillé and Variot.; and *M. leucophylla* Miquel; a list of 9 species unknown to the author; a list of 13 species of uncertain origin; an index to all the species and varieties mentioned in this paper; an index to the Japanese popular names and an index to the Chinese nomenclature.

F. D.

344. Description of the *Brachystegia* spp. and their Economic Value.

BURTT DAVY, J. and HUTCHINSON, J. *Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information*, No. 4, pp. 129-163. London, 1923.

The textile and tanning value of the bark of certain *Brachystegia* species has already been recognised, but hitherto no complete enumeration and description of the various species has been compiled. The authors have supplied therefore the lacking information and the article contains a detailed review of the distribution, full key to the botanical characteristics of 54 species, soil requirements, propagation, general features of the forest and the economic value. The genus *Brachystegia* is confined to Equatorial Africa, the majority of species being found on the great plateau between Angola and Nyasaland.

USES. — Reports of the value of the bark have been received and the following species are known to be of distinct economic value.

For making good cloth: *B. Boehmii*, *B. Woodiana*, *B. Randii* and *Berlinia globiflora* of Tanganyika Territory, Nyasaland and Rhodesia; *B. longifolia* and *B. utilis* of Nyasaland; *B. Bragaei* of Rhodesia and Portuguese Africa. *B. edulis* of Kenya, Tanganyika and Rhodesia; *Berlinia Baimii* of Angola and *Ficus natalensis*, Uganda to Natal.

For making cord: *B. Boehmii*, *B. Bragaei*, *B. edulis*, *B. filiformis*, *B. Randii*, *B. tamarindoides*, *B. utilis* and *Berlinia globiflora*.

For tanning purposes: *B. spicaeformis* Sini (probably *B. Bragaei* or *B. Brandii*) of Portuguese East Africa, 18 % tannin. *B. tamarindoides*, *B. utilis* of Katanga.

OTHER USES: — Medicinal value: *B. mpalensis* of Katanga and N. W. Rhodesia; river craft: *B. Allenii*, *B. tamarindoides*, and *B. Woodiana*; timber (for constructive purposes): *B. palensis* (of excellent quality). Other species are used for rafters, and fuel, and the possible utilisation for charcoal, wood distillation products and paper pulp is considered worth investigation; manufacture of water baskets (see SIM T. R. Forest Flora and Forest Resources East Africa).

Edible seeds: *B. edulis*; fodder: — *B. Woodiana*.

It is of interest to note that species are found growing on thin shale and quartzite soils, too poor for many other forest trees. This, combined with the fact that seed is readily obtainable, and the trees reproduce freely, are important economic factors in the problem of afforestation of tropical soils of poor quality.

M. L. Y.

345. Relation of Temperature to Blossoming in the Apple and Peach.

BRADFORD, F. C. *University of Missouri College of Agriculture, Agricultural Experiment Station. Research Bulletin* 53, p. 51, plates 5, tables 14, bibliography. Columbia Missouri, 1922.

Observations on the phenology of fruit trees in North America. The stage of development of the buds in the autumn has an influence on time of blossoming. It appears that late blossoming is connected with rest period influences rather than with differential temperature requirements.

Coefficients of correlation between heat accumulation and date of first blossoms on apple and peach trees are given, also variations in blossoming of several different varieties, etc.

These observations indicate that thermal constant conception may furnish a valuable basis for study of the response of plants to some of the factors associated with climate.

M. I. Y.

346. The Mosquito-Destroying Power of Algae Belonging to the Genus *Chara*.

PARDO, I. Observaciones acerca de la acción de la *Chara* sobre las larvas de los mosquitos. *Boletín de la Real Sociedad española de Historia natural*, Vol. XXIII, No. 3, pp. 154-157. Madrid, 1923.

As a result of his study of Prof. CABALLERO's work (1919) on the effect of *Chara foetida* upon the larvae of the genera *Stegomyia*, *Culex* and *Anopheles*, the author was induced to visit the swamp zone of Onteniente (Valencia). Here he found, in close proximity to ponds swarming with mosquito-larvae, a single large pool which, although the water was very rarely renewed, proved entirely free from these pests. The bottom of the pool was thickly covered with *Chara hispida*, a plant that as Prof. MORORE had also discovered, differs from other kinds of *Chara* in being able to thrive at a depth of over 3 m., which is a matter of great importance when it is necessary to destroy larvae in very deep water. These observations were completed by laboratory experiments. Some specimens of *Chara hispida* were planted at the bottom of a large glass jar into which, as soon as the plants had grown strongly (July 26), 6 *Stegomyia* larvae were introduced; 3 of these insects died after 2 days, 2 succumbed on the third day and the last in the fourth day. Three of the strongest *Stegomyia* larvae (which were shortly about to pupate) were left in the glass-jar which served as a vivarium for the mosquitoes, and some *Chara* plants were introduced; three days later, 2 of the larvae died and the next day the survivor perished. In similar experiments conducted by Prof. CABALLERO with *Chara foetida* the larvae did not die so soon, nor were they all killed; it would therefore appear that the larvicidal action of *C. hispida* is stronger than that of *C. foetida*.

The author describes in conclusion various observations made in the Botanic Gardens of Madrid which confirm the preceding statements; he further draws attention to the fact that the hemp retting-ponds in the neighbourhood of Valencia contain a thick growth of *C. hispida* and are entirely free from mosquito larvae.

E. P. C.

*Plant Breeding.***347. The Use and Value of Back-Crosses in Small-Grain Breeding.**

HARLAN, H. N., and POPE, M. N., *The Journal of Heredity*, Vol. XII, No. 7, pp. 319-322. Washington, 1922.

Hitherto the back-crosses of the F_1 progeny with the parent have been used almost exclusively to explain the laws of inheritance of plant characteristics, without any attempt to apply in practice the results already obtained in animal breeding, to fix desired characters in livestock.

The results obtained with smooth-awned barley are very promising. The rough awns are objectionable both in harvesting the crop and in feeding the straw. Considered from the practical standpoint, the cross Manchuria \times Lion results in a barley possessing all the desirable characteristics of Manchuria in addition to the single attraction of the Lion, namely the smooth-awned factor.

The difficulties of breeding on ordinary lines, with a view to fixing this character in F_2 are insurmountable, for example, there would be just one chance in 1 048 576 that the 20 desirable Manchuria characters would be found in any segregate, and one chance in four that this segregate would be smooth-awned.

In back-crossing, however, if the 20 characters are inherited independently there is a rapid elimination of those coming from the Lion parent. With each recross the Lion "blood" is reduced one half; in 5 back matings only $1/64$ of the blood is not Manchuria and that $1/64$ is heterozygous with only one chance in 128 of any factor being finally other than Manchuria. If there were 20 independently inherited factors it is estimated that 108 out of 128 plants would be entirely homozygous for Manchuria characters and the remaining 20 would be heterozygous for only a single character. At this point it should be possible to select the plant desired.

G. A.

348. The Inheritance of Glume-Length in a Wheat Cross.

ENGLEDOW, F. L. *Journal of Genetics*, Vol. 13, No. 1, pp. 79-100. Cambridge, March 1923.

In some cases, two phenomena are observed in the frequency distribution of biometric values in the F_2 of wheat crosses:

- 1), The presence of individuals possessing the character in question to a higher degree than their parents;
- 2) the presence of individuals in which the maximum and minimum values of the given quality are always inferior to the corresponding values in the parents.

Thus, the hybrid resulting from the cross Polish \times Kubanka has a maximum glume-length of 30.5 mm. in the F_2 , while the medium in the case of the Polish parent is 30.84 mm., therefore there must have been some shift in the negative direction (reduction).

Occurrences of this nature may be explained by the theory of multiple

factors. This hypothesis is too elastic to admit of rigorous experimental tests, though it is true that the number of factors and their individual power can be changed in an arbitrary fashion so as to give a fairly satisfactory explanation of the phenomena. On the other hand, an increase in the number of factors makes the analyses longer and more difficult; further, it is not out of place to observe as a prudent reservation that the results obtained by experiment in this field of research render probable rather than prove the existence of multiple factors.

There are also other analogous cases that might be explained in a different manner. CASTLE, in his much discussed work on rats, suggested "the modification of unit characters by selection", while GATES maintained that after crossing, "gametic purity was not always to be expected".

In the case of Polish \times Kubanka, the use of multiple factors to explain the above-mentioned shift presents considerable difficulty.

The author has had recourse to the hypotheses that: 1) there is a principal factor A and a secondary factor B; 2) possibly the number of the factors and the combinations of factors have been increased by "adding", or "multiplicating", factors, but in no case, has he been able to exactly explain the observed facts.

The negative shifting of the length value of the glume might be due to the effect of the constitution of the maternal parent upon the development of the zygote, so that the F_2 P plants derived from plants of the F_1 I (individuals of the first generation with intermediate characters), would be poorer as compared with genetically identical zygotes derived from F_0 P (Polish type). This impoverishment might certainly show itself in a negative shift of the length values in the F_2 . When an F_1 individual is self-fertilised, one of its zygotes has the same genetic constitution as the zygotes of the F_0 P parent (long-glumed Polish). The zygote formed on the F_0 I is, however, nourished by a plant differing in genetic composition from the F_1 P parent and of much reduced dimensions. It is not impossible that a zygote with the factor composition F_0 P may show imperfect development because the maternal parent (in this case F_1 I), differs from F_0 P, and hence produces inferior, "shifted" individuals. An F_2 P population composed of such individuals would have an average glume-length below that of the line F_0 P.

G. A.

349. Crosses between *Triticum* and *Aegilops*.

BLARINGHEM, L. Nouveaux faits relatifs aux hybrides de Blés et d'Aegilops. *Comptes rendus Hebdomadaires des Séances de l'Académie des Sciences*, Vol. 176, No. 12, pp. 852-854. Paris, 1923.

The author has succeeded in obtaining viable hybrids by fertilising *Aegilops ovata* and *Ae. ventricosa* with the pollen of *Triticum monoccoccum*, *T. vulgare* and *T. Spelta*. In 1920, there were found in thirty flowers of *Ae. ovata* and *Ae. ventricosa*, that had been fertilised with pollen from *T. monoccoccum* L., 4 grains one of which germinated and produced a vigorous but completely sterile individual resembling *Aegilops speltoides*. It is worth noting that nearly all the ovules of *Ae. ventricosa* were success-

fully fertilized by means of pollen from a hybrid, *Monococcum* \times *durum*, fixed in 1911 and cultivated ever since. Twenty flowers on four different plants were pollinated, the total number of kernels produced being 13. These caryopsids were all short and inflated except two that were flattened like *ventricosa*.

The largest kernel ($5.5 \times 3 \times 2.5$) weighed 32 mgm. and the smallest ($3 \times 3 \times 1$) 5 mgm., the weight of all the kernels together was 270 mgm. These grains were normal and their colour, shape and weight clearly showed their hybrid origin (Xenia).

G. A.

350. **The Dissociation of the Barley Hybrid, Smooth-Awned Black \times Rough Awned Albert.**

COLIN, H. and TROUARD-RIOLLE, V. Dissociation de l'hybride, orge noir à barbes lisses \times orge Albert. *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*. Vol. 176, No. 12, pp. 854-856. Paris, 1923.

This report gives an account of the results of a cross between white, rough-awned Albert barley and smooth-awned, black barley. The characters rough and black have hitherto been regarded as dominants in such cases, so that the F_1 should consist of black, rough-awned individuals. The author however found very little homogeneity in the first hybrid generation, taken as a whole. The character black, is dominant and in the entire F_1 , no single well-developed white grain was to be detected. On the other hand there were black, grey and white awns, a single ear often shewing both black and white awns. As regards roughness, some of the ears in the F_1 , had smooth awns only, others had smooth awns and rough awns, while in others again, the awns were smooth for half their length and rough for the remainder.

There is no correlation between colour and roughness.

In the F_2 , the seed from the smooth-awned ears, whatever their colour, produced smooth-awned grey or black ears as if segregation had taken place in the F_1 .

Only the seed of the rough-awned ears showed any sign of Mendelian segregation, the follow new typical combinations being distinguished:

Black ears	rough	smooth	smooth-rough
Grey ears	rough	smooth	smooth-rough
White ears	rough	smooth	smooth-rough

In addition to these well-defined types, all possible transitional forms were also present.

Contrary to what would have occurred had the black and the rough characters been dominants in the true sense of the word, with close correspondence to the laws of Mendel, segregation phenomena thus made their appearance in the F_1 , whereas in the F_2 , there was a predominance of black and smooth and flattened ears, and the normal Mendelian combinations occurred combined with a large number of other forms and combinations.

G. A.

351. An Abnormal Character in Barley.

HARLAN H. N. and POPE M. N. Many-Noded, Dwarf Barley. *The Journal of Heredity*, Vol. XIII, No. 6, pp. 269-273. Washington, 1923.

In 1918, at Aberdeen, Idaho, in a sowing of barley Mesa, C. I., No. 1313. (*Hordeum distichon nudum*) a single plant was discovered which differed from the rest in having short culms (total length of plant 50 cm.) somewhat ramified towards the base. many slender leaves and abnormal or badly-developed, ears.

It was only possible to obtain seed from one of these abnormal ears which was less aberrant than the others. The plants raised from this seed, although varying considerably in culm length, retained the previously mentioned fundamental characters.

Crossing experiments made by the author with the varieties Baku (*Hordeum distichon, nudum*), Manchuria (*H. vulgare pallidum*), Utah Winter (*H. v. p. pyramidatum*) and Nepal (*H. v. trifurcatum*), have shown that the anomalies, described and determined by the author are due to a Mendelian simple recessive factor. A. G.

352. The Question of the Transmissibility of the Characters, Presence or Absence of Stringyness in the pods of *Phaseolus Vulgaris*.

WELLENSIEK, S. Y. De Erfelijkheid van het al of niet Bezit van " Draad " by Rassen van *Phaseolus vulgaris* L. *Genetica*, Vol. IV, No. 5-6, pp. 443-446. The Hague, November 1922.

The three non-stringy varieties of *Phaseolus vulgaris*, Hinrich's " Marble Giant ", " Volger " and non stringy Chocolate-brown, were fertilized with pollen of the Wagenaar variety, which is decidedly stringy.

In the F_1 the lack of stringyness is dominant, in the F_2 the proportions of a monohybrid are found. G. A.

353. Anomalies in the Transmission of the Character " Colour of the Embryos " in the Pea.

BLARINGHEM, L. Hérité anormale de la couleur des embryons d'une variété de Pois (*Pisum sativum*. L.) *Comptes Rendus des Séances de l'Académie des Sciences*, No. 13, pp. 875-879. Paris, 1922.

In the classical experiments of MENDEL the yellow colour in the embryos of *Pisum sativum* is dominant over the green and hence in F_2 the proportion is 3 yellow to 1 green. In practice results are not always so simple and regular. In 1913 in the case of 18 plants of the variety " Pariser Gold " (*Pisum sativum* var. *axiphium*) one was noted which in addition to 27 normal yellowish seeds produced 2 yellow-green seeds. In 1914 the plants from the yellow and green seeds produced respectively yellow and green seeds. The greens were replanted in 1919 and then gave 11 plants with pale green embryos, while in 1920 out of 28 plants there were 25 which has only green embryos (lines 911-919) while the remaining 3 (lines

921-923) gave respectively 17, 12 and 10 green and 5-4 and 11 yellow embryos respectively.

In 1921 the experimental tests were carried out on a large scale. The yellow embryos of lines 921-923 gave yellow embryos, with only the exception of a single plant with 15 yellow and one marked with green. The green descendants of the same lines were distinguished as follows:

921:	24	yellow;	28	green;	95	intermediate	=	137
922:	15	"	32	"	117	"	=	164
923:	21	"	28	"	40	"	=	88

For the line 923 there are roughly 3 green for 1 yellow which is the complete reverse of the normal case. In addition other quite unexpected features are to be remarked. For example: a plant of line 917 gave yellow seeds for the 2 lower pods and green seeds for the 3 higher pods. It seems therefore quite impossible to trace any scheme of separation in the mendelian sense even after taking into account the presence of several independent genetic factors.

Other students have already called attention to similar cases, WHITE for the influence of climate, and ZEDERBAUER for the influence of age on the exhibition of characteristics: young specimens which are ordinarily recessive tend after crossing with more adult individuals to assume the position of true dominants.

In conclusion it may be stated that certain lines of *Pisum sativum* show great irregularities in the transmission of characters, irregularities which make necessary a strict choice of the lines to which alone they remain constant. On the other hand the irregular lines provide material which can be utilised in the estimation of the action of the environment, age and the special conditions of the crossing upon the exhibition of characteristics.

G. A.

354. Morphological Characters Used in Flax Selection.

BLARINGHEM, L., Etudes sur la sélection du lin. *Revue de Botanique appliquée et d'Agriculture Coloniale*, Year 3, No. 17, pp. 3-26, figs. 3, tables 2. Paris, 1923.

In cultivated flax (*Linum usitatissimum* L.) the reproductive organs are arranged in the manner characteristic of self-fertilising plants, the stamens reach the height of the stigmata by the time the latter are almost mature and cover them liberally with pollen. *Linum angustifolium* has also a similar marked tendency to self-pollination. Further, when emasculated, these two species cross without difficulty, in every possible combination and their hybrids produce fertile seed. The sexual organs mature in the same manner in both species. The author draws attention to the extreme sensibility to all mutilation shown by the young sexual organs of the flax plant. If emasculation is effected during the three days preceding flowering, abortion of the capsules is the almost inevitable result, while the premature removal of the anthers arrests the development of the ovary. There is a critical period in the development of the flax

flower, which takes place about the time when the bud attains a quarter of its maximum length. This sensibility is a function of the climate and of meteorological factors. Light especially has a very strong effect; flax buds even when entire and not emasculated, if bagged too early, abort in large numbers. The dependence of the reproductive organs upon external factors appears to be acquired when the buds have attained half the total length they reach the morning before the flower opens. During the morning of that day self-fertilisation takes place, but it never lasts more than two hours; the germination of the pollen grains at once begins and by the next morning the ovary has already assumed its globular form.

Upon these peculiarities in the pollination of cultivated species of flax rests the whole problem of the separation of pure pedigree lines. It is necessary to know whether the homogamy of the flaxes grown is sufficiently marked and constant in order to be sure that cross-fertilisation is only accidental and therefore does not affect the question of preserving the seed. *A priori* it would appear not to be a matter of frequent occurrence.

The flax flowers are visited by insects, but they rarely touch the pollen and never collect it since their object is the nectar. Indeed, because nectar is their only aim, accidental cross-fertilisation is very rare in cultivated flax plants, but the danger of its occurrence is not wholly excluded. The persistence of nectaries in *L. usitatissimum* shows that this species is exposed to the danger of cross-fertilisation by insects. Further, only selection and constant supervision of the lines can give any real guarantees of stability.

The author chose as type-lines suited for studies of heredity and crossing only those forms in which the stigmata at the time the flower opened were thickly covered with a mass of pollen from the stamens of the same flower. He rejected any line having one, or two flowers bearing a withered or unopened anther, and also made a very minute study of the pollens in order to find some rule of homogeneity for subsequent use in fibre-flax selection based on the percentage of abortive pollen grains (1).

It is well-known that plants obtained by crossing are most vigorous when their sexual organs are least perfect, therefore the selection of the flaxes with longest fibres means the choice of those with defective reproductive organs. It may well be that the degeneration taking place in Russian flaxes when transported to Western Europe is due to this correlation, since cold climates are favourable to homogamy and temperate climates to dichogamy.

After describing the characters of a good fibre flax, the author points out that these clearly depend upon stem growth, and the same line does

(1) See L. BLARINGHEM Sur le pollen du Lin et la dégénérescence des variétés cultivées pour la fibre. *Comptes rendus Acad. des Sciences*, Vol. 172, pp. 1603, 1921, R. November 1921, No. 1106. (Ed.)

not produce fibre of the same kind every year. On the other hand, it must be recognised that a flax producing much tow may give a very low yield of industrial fibre, whereas long fibres may be obtained from a flax with little tow. Before beginning selection, it is therefore necessary to take into account the qualities required for any given centre of flax-growing.

In the problem studied by the author there are two essential and distinct questions to be considered :

1) Are there any grounds for expecting that a seed of flax possessed of the required characters will be able to transmit these characters for a sufficient number of generations to render seed production profitable? In other words, is the degeneracy of the Russian flaxes capable of being lessened or prevented? The author has already expressed his opinion to the effect that Russian flaxes are mixtures of hybrids and of fixed lines. This he tested with one type *E. G. B. K.* which after cultivation for 4 generations in France, remained as fixed as the most stable lines grown for seed production.

Experiments made on French and foreign flaxes cultivated for fibre showed that each group consisted of easily separated fixed lines and hybrid lines. Practically the only way in which the problem can be solved is by applying this knowledge to flax-growing on a large scale.

2) Can these pure lines produce the quality of fibre required by the the industry after they have been grown in certain centres? It is probable that definite types will be found yielding excellent results in one or another centre, but time would be saved and pure line testing made easier if growers for the flax trade would confine their efforts to the selection and cultivation of only two, or three, types.

In his search for control characters (purity of type) and selection characters (corresponding to the increase or decrease of a quality), the author has turned his attention to the colour of the flowers, the colour of the seed and the type of the capsules.

a) *Colour of flowers.* — Miss TINE TAMMES (1) has proved that as regards the colour and size of the petals, there are at least 8 independent factors which act in more or less complete correlation with the colour of the anthers and of the seeds. The seed colour depends partly upon a factor that intensifies the pink of the stamens and petals. On the other hand, seeds of a yellow colour incline to a greenish shade when the factor producing curling of the petals and a yellowish colour in the anthers is present. The latter characters are associated with somewhat pronounced abortion of the pollen, therefore the aim of selection must be to eliminate them. The author intends to confine his work to the selection of flaxes with white flowers and brown seeds.

b) *Colour of the seeds.* — This furnishes a series of terms for prac-

(1) TINE TAMMES. Genetic Analyses, Schemes of Co-operation and Multiple Allelomorphs, *Linum usitatissimum*. *Journal of Genetics*, Vol. 12, pp. 19-46, 1922.

tical comparison. Seed-colour, however, appears to be independent of the other characters of the plant. Thus, although in the first test of the purity of the seed the colour of the episperm may be taken as an indication, it is not an infallible guide.

c) *Capsules*. — A test analysis of the pure origin of fibre flaxes must include an examination of the capsules, if well-founded, indisputable guarantees are required. This process, it is true; interferes with the sale of the seed, and when it is a question of selected seed, the seed-coat is best left until just before sowing.

The author subsequently studies the significance in each type of the variation in the height of the stalks, the size of the fruit clusters, the length of the peduncles of the first fruits, the distance between the sepals of the ripe fruit, the shape of the fruits, the number of seeds per fruit, the relative width of the false dissepiments and the shape of the seeds, all of which characters were measured, or used as a basis for classification into different categories.

The shape of the seeds gives accurate information in the case of seed-flaxes, but is of no value in that of fibre-flaxes, owing to the very variable percentage of aborted seeds.

For the controlling of line purity there is one character that can be relied upon as marking the origin of the seed, this is the presence, or absence, of the small hairs bordering the edge of the false dissepiment turned towards the axis of the fruit. These processes are very stable and are nearly always independent of the other characters of the lines studied. Out of all the cultivated flaxes examined by the author only the Morocco and the white seeded varieties proved pure as regards these hairs, all the others showing evidence of much impurity. In order to preserve the purity of his varieties of flax, the grower need only take two precautions: he must sow the pure seed after carefully cleaning the sacks, seeders, etc., that are used, and at harvest time should clean separately, and as far as possible on the field itself, the plants that have been pulled up with sufficiently ripe seed to be used for sowing.

From 1918 to 1922, the author noted several kinds of seed-flaxes which proved to be quite useless for the production of commercial fibre, but owing to their great regularity of growth, are types eminently suited for the study of the chances of cross fertilisation and the analysis of the characters of pollen as affected by the age of the flowers and changes of climate.

The same fixity is nearly always met with in *Bombay flax* but some lines have shown certain irregularities of growth, these are however regarded by the author, as recent hybrids, although he has not yet proved this point. *White Seeded flax* grows with extreme regularity and never produces hairs, regular growth is the best character to select for analysing fibre flaxes.

On the other hand, the progeny of fibre-flaxes show great irregularity; only in the lot *E. B. G. R.* are hairs always present together with true homogeneity in the pollen and the maturation of the fruits.

R. D.

355. **Selection of Coconuts.**

JACK, H. W. (Economic Botanist, Department of Agriculture, F. M. S. and S. S.). *Malayan Agricultural Journal*, Vol. X, No. 5, pp. 122-127. Kuala Lumpur, 1922.

The use of coconut oil and vegetable oils in general, have increased to such an extent that the quantity of copra exported from the Federated Malay States has grown from 16 404 piculs (1 picul = 133 lb. apx.) in 1904, to 419 988 piculs in 1920. The importance of increasing the yield per tree is evident and selection and breeding experiments have been started in South India, the Philippines, Java and the Federated Malay States. The chief character of economic importance is that of copra production, and the number of nuts given by a tree is not a reliable index, owing to the variation in size of the nuts, thickness of meat, etc.

A study was made of 453 trees and it was found that the yield of nuts per annum varied from 7 to 180; also, selected nuts were planted in half-acre test plots and there are indications that at least 10 % of the daughter trees do not come true to type.

It is suggested that 40 acre blocks in the best areas of estates should be chosen for selection of seed nuts, and that all trees in that block should be numbered and the yield in nuts recorded. The amounts of dry copra from the nuts of each tree should then be ascertained. Note should be made of the environment of the best trees as they may be in favoured situations. It should be possible to find in a block of 40 acres, 100 trees yielding fully 110 nuts per annum. The production of pure strains of coconuts has recently been undertaken by the Department of Agriculture. The type of nut to select appears to be a medium sized, round coconut.

The Chemical Division has carried out experiments with a view to the selection of types of nuts by means of the quality of the contained oil, but results do not show that the oils obtained from the different types vary to any appreciable degree.

The Botanical Division has collected seed-nuts from 18 local varieties and has imported seednuts from Borneo, Java, Ceylon, Seychelles, South India, Cocos Islands, Panama, Burma and Madagascar. These have been planted in the Government Experimental Coconut Estate, which, it is hoped will able to do much during the next few years to solve some of the problems connected with this crop.

W. S. G.

356. **Chestnut Hybrids (*Castanea japonica* × *C. americana*).**

DEYLEPSEN, J. A. and RUTH, W. A. An Orchard of Chestnut Hybrids. *The Journal of Heredity*, Vol. XIII, No. 7, pp. 305-310, figs. 5. Washington, July, 1923.

The authors give a description of the Japanese chestnut *Castanea japonica* and the American chestnut (*C. americana*) respectively, as well as of the hybrids resulting from a cross between the two species.

The Japanese chestnut has the advantage of bearing large fruits that are easily separated from the cupule which is relatively small; further it is resistant to the weevil (*Balaninus* sp.), and flowers and ripens its

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fruit early. The nuts have fewer prickles and are of a better colour than those of the American chestnut.

C. Americana bears three small nuts in each cupule to which they adhere tightly. They are less attractive in colour, but have thinner skins and the cupule has more prickles. The quality of the pulp is finer. The tree grows rapidly and vigorously whereas *C. japonica* has a habit resembling that of a fruit-tree.

The objects of the cross were to unite in a single type the good qualities of both parents and to eliminate the negative characters.

In the F_1 , three plants were obtained called Blair, Boon and Riehl. The first two produced three chestnuts in each cupule (like their American parent) but the cupule of the third only contained one well-developed nut, the two others having remained small and abortive.

In vigour of growth, productivity and early bearing (at the fourth or fifth year), the hybrids were clearly superior to both their parents.

Of the three F_1 individuals, "Boon" took the first place for vigour, early bearing, and the quality and quantity of the crop. From it ENNICOTT obtained 175 seed plants hoping that thus would produce a stock of equally valuable trees.

The results of the F_2 were quite different from what had been expected. Owing to segregation, the hybrids were far from homogeneous, some trees 14 years of age only reached the height of 2 ½ metres, while others in their neighbourhood grew to 7 metres. Further, none of the F_2 hybrids were as vigorous, fertile and productive as those of the F_1 . They did not bear fruit until between the fifth and eighth year. The chestnuts ripened from the beginning of September until the middle of October with individual variations forming a series of intermediate values connecting the extreme parental types.

The size of the fruits also offered clear proof of segregation; the Boon chestnuts were intermediate between those of the two parents, whereas F_2 some of the trees bore fruits as small as those of the American Chestnut, while others produced fine large nuts like *C. japonicum*, all the intermediate dimensions being also represented. Similar variations were also observed in the case of the prickles and other characters.

The behaviour of the F_2 suggests the possibility of multiple factors being concerned in the transmission of the characters in question.

An attempt was made to propagate vegetatively (by means of grafting) the valuable properties of the F_1 , it, however, proved unsuccessful, as the grafts did not take.

G. A.

Seeds.

357. Physiological Studies on the Action of Formaldehyde on Wheat.

ARWOOD, W. M. (Oregon Experiment Station). *The Botanical Gazette*, Vol. XXIV, No. 3, pp. 233-263, figs. 12, bibliography of 58 works. Chicago, Ill., 1922.

Hitherto, the injurious action of formaldehyde has been estimated from the results of germination tests, but these are probably not suffi-

cient evidence, for as STEPHENS has found, the vitality of the seeds is lowered, therefore though they may germinate, they will produce less vigorous plants. The author has consequently carried out some direct tests for the purpose of determining, not only the germinative capacity of seeds treated with formaldehyde, but also the effect of the latter upon the respiration and the diastatic and catalytic action of the plant. In these experiments, commercial formalin containing 40 % (or more accurately, 39.3 %) in volume of gaseous formaldehyde was used. The dilutions that will be mentioned all refer to this solution.

Germinating capacity. — Formalin diluted to 1 : 320 was allowed to act for a time varying from 5 to 300 minutes, after which the seeds were placed to germinate on damp blotting-paper, or planted in the ground; in the latter case, a certain number were kept in the laboratory. Nearly all the seeds on the blotting paper germinated, but a larger or smaller number of those planted in the ground perished, especially when the formaldehyde treatment was prolonged beyond 30 minutes; the toxic action was more marked in the seeds that had been planted out-of-doors than in the case of those kept in the laboratory. Oats had already been reported by CRANFIELD to behave in the same way; this was subsequently confirmed. WALDEN gives the following explanation of the greater mortality among the seedlings growing out-of-doors. The formaldehyde injures the hypocotyl, which has difficulty in overcoming the resistance of the soil, therefore the seedlings growing in the ground die very easily. Other experiments have been made in which the concentration of the formalin varied from 1 : 320 to 1 : 40; the length of treatment being in every case 10 minutes, and the temperature 20° C. A rapid fall in germinating capacity was observed as soon as the concentration was higher than 1 : 160.

The author has also experimented with the polymers of formaldehyde, substances easily obtained by the action of low temperatures, concentration, or drying. These compounds have not yet been individualised and pass under the generic name of paraformaldehydes. An unsuccessful attempt was made to hinder their formation. Spraying with paraformaldehyde has proved to be extremely injurious, more than 90 % of the seeds having been killed by this means, a result confirming the previous observations of COONS and MCKINNEY and of Miss HURD.

Permeability. — This was ascertained by the author who fixed some isolated seeds at the bottom of test-tubes (using glue for the purpose) and filled the tubes with a formalin solution. After 3-4 days, the projecting part of the seed was cut off and treated with SCHRYVER'S formaldehyde reagent. The formalin was found to penetrate into the seed when the concentration was sufficiently high *e. g.* 1 : 8.

The author has also carried out an indirect test based on the work of BROWN, who demonstrated that the seeds immersed in a solution behave differently according to whether their integument is permeable or semi-permeable, that is, whether the solution can, or cannot, reach the seed itself. Thus, when the external osmotic pressure is less than the internal osmotic pressure, and the seed has a permeable integument,

the seed continues to imbibe the solution slowly, until an equilibrium between the two osmotic forces is reached, and therefore its weight undergoes no alteration. If on the other hand, the integument allows the substances in solution to pass through it, the increase in weight is rapid and the curve denoting it quickly becomes flattened. If pure water is substituted for the solution, the seed only loses some of its weight when the integument is permeable; in this manner, an inversion of the curve is produced. This characteristic behaviour is shown by seeds of wheat in the presence of formaldehyde as can be seen by reference to Fig. 80 which gives the results of a test carried out in triplicate, with a 1 : 8 formalin solution on samples of 3.5 gm. for 292 hours. The inversions of the two curves denote the passage of the seeds from formalin solution into water and *vice-versa*.

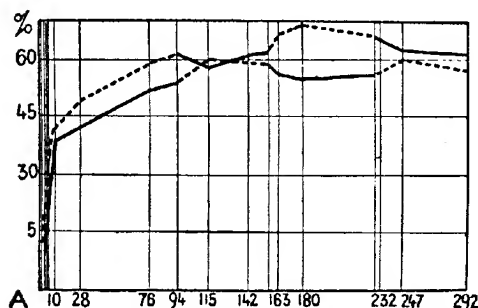


FIG. 80. — Variation of weight of seed wheat plunged alternately in water and in 1 : 8 formalin.

A = hours.

Continuous lines (1) = Immersions in formalin.

Broken lines (2) = " " water.

This test shows that formaldehyde does penetrate into wheat grains, although slowly and with difficulty. The permeability of wheat grain by formaldehyde acquires a special significance in the light of the researches of COLLENS, which prove that the substances in solution are diffused within the seed through the embryo; this explains the considerable injury produced, even when the penetration is slow and difficult.

Diastasic activity. — The author has studied the action of formaldehyde on the saccharification of soluble starch effected by the diastase ferment (diastase Merck). All the experiments were in duplicate; the heights of the columns give the amount of starch still undigested after 1 ¼ hour at 40° C. It is found that pure formalin (at 1 : 1 and 1 : 10) completely arrests digestion and neutralises the action of diastase. At lower concentrations, formalin only hinders saccharification, as has been shown from the fact that the operation took place, after 65-6 hours, in almost all the tubes.

The author has conducted other experiments directly on seeds. These were treated with formalin at different concentrations (from 1 : 320 to 1 : 80). The seeds were left to drain for 2 hours in a current of hot air, dried, ground and extracted. The extract obtained was added in amounts varying from 5 to 20 cm³, to soluble starch. After an hour, the digestion

was seen to be more or less retarded, as compared with the controls (extract of seeds immersed in water) in which the process was already complete. The arresting action was especially noticeable in the case of strong concentrations.

Respiratory activity. — Respiratory exchange is a fundamental vital process, for which reason the author has made it the subject of many careful investigations. These he carried out according to the usual methods, on 160 lots of seeds some being placed in water and others in formalin solutions of various concentrations for 10 minutes. The carbon dioxide was estimated with barium hydrate. The experiment lasted for some hours.

It was found that the respiratory activity of the latter seeds was considerably reduced, as compared with that of the controls, when the concentration of the formalin used was 1:80, but while the depressing influence was still noticeable down to 1:320, it practically ceased at concentrations of 1:400 and 1:1000; therefore the 1:320 solution commonly used is very near the innocuous limit. Owing to the excessive growth of *Rhizopus* due to the hot, dry air of the respirometer, the author was unable to extend his experiments to the seedlings.

Oxydising capacity. — Formaldehyde reduced the capacity of the seeds for liberating the oxygen present in oxygenated water. This is well shown in a graph, where the heights of the columns give the cc. of oxygen liberated by extracts of the seeds at 28° C. When the correction for pressure is made, and the weight of the seeds is reckoned at 1 gm., the various lots are found to behave almost identically.

These researches show that formalin in the usual concentration of 1:320 only slightly reduces the germinating capacity of wheat seeds but it perceptibly hinders their diastasic power, depresses respiratory exchange, and hinders their catalytic action. It is probable that the sum of its effects is to *reduce vitality*, even in the seeds that retain their power of germination.

It would be well to extend these experiments to the above mentioned proteolytic processes, and to determine the effect of the immunising treatment and subsequent washing proposed by BROWN and HURD as the best means of preserving the physiological activity of seeds dressed with formaldehyde and of militating against the injurious effects of this treatment.

I. V.

358. Modern Seed Testing : The New Zealand Official Seed Station.

Fov, N. R. (Biological Laboratory, Wellington). *The New Zealand Journal of Agriculture*, Vol. XXVI, No. 2, pp. 65-72. Wellington, 1923.

The author mentions the work carried out at the principal seed stations throughout the world with special reference to the two leading stations at Zurich and Copenhagen. This is followed by a detailed description of the system adopted in New Zealand by the Official Seed Station in collaboration with the Biological Laboratory of the Department of Agriculture. Two recognised methods have been tried, the Continental and

the Irish but up to the present the latter method has been found more economical and practicable.

Germination tests are made in 3 specially constructed germinators:

1) the all-metal water bath type (enclosed on all sides by a water jacket), used for the testing of more difficult seeds such as rye grass cocksfoot, dogstail and fescue; 2) the glass wooden-frame type for all clovers, crucifereae, cereals, peas and vegetables; 3) the small water bath type, for paspalum, *Poa* species, etc. where a high temperature is required. With the exception of paspalum, and *Poa* species (95° to 65° F) cereals at ordinary room temperatures and peas 75° to 60° F, all seeds are germinated at a temperature from 85° to 65° F subsequently rising to 85° for 8 hours, and then the temperature lowered to 65° for the remaining 16 hours.

Peas and beans are soaked in water for 16 hours before placing in the germinator, damp sawdust being used for the beans. Four counts are made of each sample, the intervals allowed vary according to the class of seed under test; the number germinated is entered on the record card.

In the purity analysis the percentage of extraneous seeds is given by weight.

After the second germination count, a report is forwarded to the sender of the seeds stating the average germination after a specified number of days, and the percentage of impurities. This facilitates discrimination as to the ultimate value of the species and the interim report also gives a good indication of the vitality of the type. The final report at the close of the testing period registers the intermediate and final germination, each after a certain fixed number of days, and in the case of purity tests, the percentage of extraneous seeds and a complete list of the impurities.

Any peculiarity noted about the sample, such as the presence of mites, etc. is also reported, allowances are also made for hard seed coats common with clover seeds.

In addition to germination and purity tests, research is being made relative to seed storage, loss of vitality and improved methods of testing.

M. L. Y.

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D. V. S.

360. HAMED, MAHMOD (Inspector, Physical Department, Cairo). Experiments with Evaporimeters. *Cairo Scientific Journal*, Vol. XI, No. 108, pp. 10-14, figs. 2. Cairo, 1923.

The *Piehe* and *Wild* evaporimeters are described, and details given of experiments carried out to ascertain the influence of edge evaporation on the accuracy of results.

W. S. G.

361. HENDRICK, J. (University of Aberdeen). Fertilisers before and after the War. Reprinted from *Transactions of the Highland and Agricultural Society of Scotland*, p. 22. Edinburgh, 1922.

Professor HENDRICK reviews the position of the fertiliser industry from the year 1840 to the present time. He alludes to the dye and drug industries and points out that these do not give employment to more than a fraction of the labour required in the manufacture of fertilisers. Attention is drawn to the importance of the synthetic process for fixation of nitrogen. He considers that owing to competition amongst producers fertilisers will be cheap, also, that the variety is now greater than before and in consequence the farmer requires more knowledge respecting fertilisers and their uses.

W. S. G.

362. GILCHRIST, P. S., Trend of Modern Fertiliser Plant Construction. *Industrial and Engineering Chemistry*, Vol. 15, No. 1, pp. 86-87. Washington, 1923.

A detailed description of the construction and manipulation of a modern fertiliser plant.

D. V. S.

363. BALY, E. E. C. (Liverpool University). The Growth of Plants. *Chemistry and Industry*, Vol. 42, No. 11, pp. 256-258. London, 1923.

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Dr. S.

366. CHARLTON, J. (Agricultural Chemist, Burma). The Determination of Prussic Acid in Burma (*Phaseolus lunatus*). *Bulletins Issued by the Agricultural Research Institute, Pusa*, Bulletin No. 140, pp. 1-7. Calcutta, 1923.

The author gives the prussic acid content of Burma beans (*Phaseolus lunatus*).

D. V. S.

[361-366]

367. BOERNER, E. G. (In charge of Grain Investigations) and ROPES, E. H. (Specialist in Grain Investigations). The Test Weight of Grain: a simple method of determining the accuracy of the testing apparatus. *Bulletin No. 1065*, United States Department of Agriculture, p. 13, figs. 8. Washington, 1922.

The "test weight per bushel" is one of the chief factors in the grading of grain, hence it is essential that the "test weight" be accurately determined.

The authors describe the apparatus required for taking the test weight per bushel (1) also, variations and special points to observe in making correct weight-bushel tests. Methods are given for the determination of the accuracy of the test kettle and the sensitiveness of the beam of the balance. A table of equivalents is given and its use explained.

W. S. G.

CROPS OF TEMPERATE AND TROPICAL COUNTRIES

(INCLUDING FORESTRY).

SYNTHETIC ARTICLES.

368. **Crops and Vegetable Products in Kenya and Uganda.**

GRAY, W. S. *Technical Adviser, International Institute of Agriculture, Rome.* (2)

The countries of Kenya and Uganda lie immediately below the Equator but the climate is far from being uniformly tropical owing to the contour of this part of Africa. The land rises more or less steadily from the coast to the highlands, where on the western side of the Great Rift Valley the Mau escarpment attains an altitude of 9000 feet and then falls somewhat rapidly to 3600 feet on the shores of Victoria Nyanza and more slowly in passing from the south to the north of Uganda. As a result of this conformation the climate varies from purely tropical on the coast to almost that of a fine English summer in the extensive highland areas which are healthy and suitable for European settlers.

The annual rainfall varies from 25 to 75 inches according to the district and there are two rainy seasons, with the result that in many

(1) See B. 1917, No. 271. (Ed.)

(2) The material for this article was obtained during the author's residence in East Africa and as a result of visits to plantations and farms, supplemented by information from official sources. (Ed.)

parts of the country two crops can be harvested in one year from the same land.

There is probably a sufficiency of native labour but in Kenya most of the tribes are rather unintelligent and the average native dislikes any form of continuous labour ; hence a great deal of time is wasted in teaching new boys the rudiments of agriculture. These remarks apply to a much less degree in Uganda where the natives are generally of a higher type.

The question of environment and climate in relation to the development and yield of cultivated plants is now being studied by many investigators, and if the best results are to be obtained there must be a practical application by way of selection of the crops most suited to the weather and soil conditions of the particular district ; for instance, flax is practically confined to the highlands of Kenya where there are deep, well drained soils and a heavy and well distributed rainfall may be expected. On the other hand the coconut palm is limited to the coastal belt and maize will thrive under widely differing conditions of climate and soil.

FIBRE CROPS: Cotton. — This crop is very largely grown in Uganda at altitudes below 4000 ft. and in districts where the difference between day and night temperatures are not too strongly marked. Owing to waterways and excellent roads internal transport is good, but at present the only outlet to the coast is by the Uganda Railway, a single track which is inadequate for the expansion of commerce until improvements are effected. This fact has a direct bearing on the development of all crops as there is often great delay of goods in transit and no certainty that products will reach the European markets promptly. Until means of transport are improved no great extension of the area under cotton can be expected. The best soils are deep, light, reddish loams with gravel subsoils. Most of the so-called black cotton soils are too retentive of moisture and are generally situated in areas where drainage is difficult. The varieties grown belong to the American long staple type, such as Allen, Sunflower and Nyasaland, the latter having been acclimatised in Nyasaland and introduced into Uganda a few years ago.

Almost the whole of Uganda under 4000 feet is suitable for cotton-growing but the soils are patchy, and large, homogeneous areas are difficult to find. Parts of the Buganda Eastern and Northern Provinces may be regarded as the most suitable districts ; the Eastern Province has the additional advantage of water transport on Lakes Kioga and Kwania. There is a considerable population and the native appears to have taken up cotton-growing seriously, but needs encouragement and instruction by the Government in modern methods of cultivation.

Cotton is grown exclusively by natives in small plots of $\frac{1}{4}$ to 1 acre and the product is sold in the public markets or to the ginneries. The yield is less than 300 lb. per acre, which is not satisfactory as on Government plantations under better methods of cultivation, over 400 lb. are obtained. The figures given below show the yields in 1921 from

one of the Experimental Farms under the control of the Department of Agriculture :—

	Yield	Staple
Var. Allen (No. 14).	445 lb lint per acre	1 $\frac{3}{16}$ inch
Var. Sunflower	458 " " " "	1 $\frac{3}{16}$ " "
Var. Allen	494 " " " "	1 $\frac{3}{16}$ " "

There are two seed Selection Stations in the Protectorate and a great deal of work is being done in connection with seed control and distribution and the instruction of the natives in modern agricultural methods.

The seed is sown and the young plants thinned out to a distance of about two feet. Planting takes place in the Eastern Province during June and July and picking begins in November. Picking is not well done by the natives generally: small pieces of broken leaf are gathered with the cotton and are very difficult to remove in ginning.

The crop does not offer much attraction to the white planter owing to the difficulty of obtaining and keeping up a sufficient supply of labour, in a country where the natives do not care for any permanent and continuous form of employment. No European could live on the proceeds from small plots, but would have to take up large areas, in which case the danger of outbreaks from pests and diseases would be considerable. Complaint is made as to taxation and the unrestricted granting of ginnery sites in districts already well served, the result being that ginneries are unable to work at their maximum capacity and therefore economically. A cheap form of power for ginning factories is obtained by distillation of cotton-seed and the production of power gas. In Egypt roller-gins are exclusively employed and turn out better quality lint, but in countries like Uganda where labour is less skilled saw gins find many advocates, as they are easy to keep in order, less costly for maintenance and give a much larger output. The average weight of a cotton bale in Uganda is 400 lb. and density 30 lb. per cubic foot.

As regards prospects of largely increased areas under cotton in Uganda, Kenya Colony and Tanganyika Territory, such increase will undoubtedly come, but it will be slow owing to the necessity for instructing the native in methods for cultivation, especially in Kenya and Tanganyika. It has been suggested that the white settler in Tanganyika Territory should grow his own cotton, but of reasons given above such a policy would be very hazardous, although the country has large areas suitable for the crop. There is an excellent district in the Kavirondo country of Kenya where soil, climate and labour are all apparently suitable for cotton growing.

FLAX (*Linum usitatissimum*) can be grown in temperate and sub-tropical countries but during the period of growth the temperature and rainfall conditions should not vary too widely or the plants will develop irregularly and the quality of the fibre will be affected. In Kenya there were in 1922 over 20 000 acres under flax and there are in the high-lands large areas at altitudes of from 6000 to 8000 ft. where the soil is

deep and well-drained and climatic conditions suitable. The chief rainy season is from April to June and the lesser rains occur from September to November with a total fall of 50 to 80 inches, which makes it possible to pull two crops of flax in one year, and also extends the retting period over about seven months. A common fault with new settlers owing to their lack of agricultural knowledge, is to sow flax on newly-broken, badly cultivated land, and often they will not take advice, with the result that they obtain very uneven crops of low actual value. A well made, even seed-bed is essential, otherwise the seed will be buried at different depths, growth will be unequal and the resulting fibre will not be uniform. The selection of seed is a matter of great importance and only the best fibre strains should be bought ; there is a quantity of seed in the country which is suitable for seed production only and not for fibre, and settlers would be well-advised to communicate with the Department of Agriculture before making local purchases. Seed imported from Europe is often found on arrival to have lost germinating power. The writer had occasion to test over 600 bags of flax seed which before leaving England had a germination capacity of 96 %, but soon after arrival in Africa was found to average 55 % only, with variations of from 89 % to 7 %. The matter was investigated and experiments indicated that in addition to the effects of heat or damp in transit, pressure is an important factor to be taken into account ; this pressure is considerable in the case of bags lying under a heavy cargo in the lower part of the hold of a ship. Only very rough experiments could be carried out but the results led to the suggestion that all seed exported for sowing purposes should be packed in barrels instead of bags, as in this way the seed would be protected from both pressure and damp. A good sample should be plump and fairly uniform in colour and size. As regards the sowing itself, a drill is probably best but excellent results are obtained with the " fiddle ", provided that the land is rolled before and after sowing. The young plant appears above-ground in 5 or 6 days and the flax is ready for pulling in about 4½ months. The quantity of seed required varies according to soil and climate, but about 85 lb. per acre with seed of 95 % germination was found to be correct at an altitude of 7000 feet. In Ireland, flax is pulled when green, but in Kenya a loss of fibre will result if harvesting takes place at such an early stage. Water-retting has not hitherto proved very successful in East Africa, probably because many of the upland waters contain iron, which would be unfavourable to bacterial action. Dew-retting is usually preferred and is carried on during the rainy months, the process occupying about 20 days ; long exposure to the sun lowers quality and gives the flax a reddish colour. African natives when trained make fairly good scutchers but as they will rarely work continuously for more than a few months, it is difficult to keep a factory supplied with skilled boys.

The yield is low when compared with that of Europe and the ratio of tow to flax is high, probably owing to inferior cultivation and lack of good scutchers and also to the effects of the tropical sun on the ret-

ting straw. The following figures show the yield from crops grown in 1920 and 1921 which came under the writer's notice:—

Flax Fibre = 2.45 cwt. per acre
Flax Tow = 1.23 " " "

The ratio of 2 : 1 compares favourably with that usually obtained in East Africa where the yield of tow is often equal to that of flax. The grade of the fibre is medium and the grade of the tow is high as a rule.

Contrary to experience in England the writer found, as a result of some experiments that phosphates had a marked effect on the crop, probably owing to a deficiency of this constituent in the soil.

The following diseases are met with:—

1) "Yellowing" or "Browning". *Asterocystis radialis*, which attacks young plants. The stems and leaves turn yellow and then brown and the plants have a scorched appearance. When small patches are noticed they should be burned at once, and if larger areas are affected flax should not be grown on that land for some years.

2) "Wilt" — due to *Fusarium lini*. Seed may be treated with a weak solution of formalin (1 : 300) in order to kill any spores. Land which is affected with wilt should be abandoned for flax growing.

When estimating the quality of a sample of flax the following points should be noted: Colour and uniformity, weight, length, silkiness and fineness and general cleanliness. The appointment by the Government of official graders was a step in the right direction, as it is essential to standardise a product if the best market prices are to be obtained. It is greatly to be regretted that owing to the necessity for economy on the part of the Government this grading is to be discontinued, as complaints have been made as to the want of uniformity in Kenya flax consignments, which such a system would soon remedy.

OIL EXTRACTION. — Comparatively little use is made of a large proportion of the flax seed, apart from that required for sowing, on account of the high cost of transport and the absence of large oil mills in the country. Such mills must be on a sufficiently large scale to allow of economical management and should then prove to be a profitable investment. To ensure success the interests of the grower of the seed and the owner of the mill must be identical and a cooperatively owned mill would be a very effective means to this end. Both Kenya and Uganda produce a great variety of oil-seeds, including sim-sim (*Sesamum*) groundnuts (*Arachis*) and the castor-oil plant (*Ricinus* sp.) which grows wild in many parts.

The yield of oil depends upon the seed and also upon the method of extraction which in the case of linseed is as follows:—

Extraction	by Solvents	about 32 %	of weight of seed
"	" Hot Press method	" 27 %	" " "
"	" Cold "	" 20 %	" " "

The Hot Press method would probably be the most suitable as the solvent process requires the use of volatile and expensive liquids such

as ether and a technical staff. If a convenient unit be taken such as 5000 acres under flax grown for fibre, after allowing for seed requirements, the yield would be somewhat as under:—

5000 acres flax yield	1000 tons linseed
1000 tons linseed "	270 " oil
and residue of cattle cake.	700 "

If the flax were grown for seed only and a seed variety chosen, the yield would be at least double and the output of oil and cake would be in proportion. Further, the same mill could be adapted for the expression of oil from seeds other than flax seed, and lubricating oils might be manufactured, in which case the Uganda Railway would be an important local customer.

SISAL (*Agave sisalana*). — Sisal hemp cultivation has proved to be one of the most successful of Kenya's industries and in 1920 it was grown on more than 30 000 acres.

Sisal is often considered to be a crop for poor dry land, and some of the finest fibre is produced near Mombasa on rough, stony soil which appears to consist of little more than sand and coral, however, when grown on better soil in the highlands the yield is heavier and labour is also cheaper, thus counterbalancing the increased cost of transport to the coast.

Sisal cannot be grown economically on a small scale owing to the cost of factory and plant, and in the selection of land consideration must be given to configuration, as tramways are usually laid for transport purposes; a good supply of water is also necessary for washing the fibre. The plant begins to give a return in from three to four years, after which leaves may continue to be cut for three years, during which time the yield should be about 1 ton of fibre per acre per annum.

The fibre is separated by crushing and scraping the leaves in a machine soon after cutting; the fibre is then well washed and dried in the open air. The fibres are from 3 ½ ft. to 5 ft. in length and are yellow-white in colour and rather harsh to the touch. It is similar but inferior to Manila hemp for rope making, but has many other uses and will probably maintain its position as one of the most important of all fibre plants.

FOOD AND OTHER CROPS: COFFEE (*Coffea arabica*). — This crop occupies about 12 000 acres in Uganda and over 30 000 in Kenya, of which one half are in the Kikuyu district near Nairobi. One variety called "Nandi coffee" is found wild in the highlands. Coffee thrives at altitudes of from 4000 to 6500 feet, and on a variety of soils, provided that they are well drained. Forest land is generally suitable for plantations as the soil is often deep and rich and contains a high percentage of organic matter, which retains moisture, an important point in the case of a shallow rooted crop such as coffee.

Adequate capital is essential for coffee planting as there is practically no return until the fourth or fifth year, by which time not less than £15-£20 per acre will have been expended.

The selection of good seed is important as the shrubs bear for 40 or 50 years and carelessness in this respect will reduce profits over a long period.

The seeds germinate in about six weeks and the young seedlings should be ready for transplanting in from twelve to fifteen months; the distance between the plants depends on various conditions but 8 x 8 feet is usual, in which case about 600 plants will be required per acre. There are many small, but important details in connection with planting out for which the novice should get expert advice and assistance, among these are making the holes, preparing and filling in the soil, protection of the plants against cutworms, etc. Coffee shrubs thrive best in the shade of trees; the selection of the species will depend upon the locality but *Grevillea robusta*, a leguminous tree and a quick grower, is one of the best and can be used also as windbreak. The soil round the shrubs need not be kept bare, but grass is very harmful and must be destroyed. The fruit, or "cherry" is borne on new wood, hence the old wood is pruned away; some growers leave the top of the shrubs to form an "umbrella" which acts as a protection from hail. The yield per acre may be from 5 to 10 cwt., or even more, according to soil, altitude and season. After picking, the pulp is removed from the "cherries" by a simple machine and the "parchment coffee" is left for about eighteen hours to ferment in order to facilitate the removal of the mucilage which adheres to the berries. The berries are then washed and dried in the sun or in a mechanical dryer. The product is at this stage known as "parchment coffee", as each berry is still covered by a thin, tough, parchment like skin. The crop can be exported in this form, or sent to a curing factory to be peeled and polished by machinery. Whenever possible the coffee should be graded by an expert as in this way a higher price will be obtained on the London market. It is probable that in the future the estates will be grouped together in the form of Companies, which would tend to standardise the product and place the industry in a stronger position.

SUGAR CANE. — This crop has been grown on a small scale only up to the present time, but developments are now taking place and in the vicinity of Kisumu a considerable area is being planted with cane, and there is every prospect of the establishment of a large industry in the near future. The Uba and striped Bamboo varieties seem to be the most successful but more experimental work is necessary in order to decide which varieties are best suited to the country. It has been shown that cane grown on high land is richer in sugar but lower in tounage than that grown on low land. Fertilisers increase the tounage but do not affect the sucrose content of the cane. The manufacture of commercial alcohol from molasses would form a valuable by-product industry. Ether is obtained from alcohol by distillation with sulphuric acid, and motor spirit, for which there would be a local market, consists mainly of a mixture of denatured alcohol and ether.

MAIZE is the most widely cultivated crop as it will grow under various climatic conditions and on almost all soils except clays. The crop will give a return in about four months at lower levels, but requires six

to seven months to mature at a height of 7000 ft. which is therefore about the limit for profitable cultivation. The yield varies from 40 up to even 80 bushels per acre. Maize is grown both by the native and the white settler and is the only cereal usually given to horses or cattle; when ground it is known as "posho" and forms the staple food of the native. The white, flat varieties yield heavier crops than the round, yellow maize. The crop is easy and inexpensive to grow as the native understands its cultivation and there would be a large export trade if it were not for heavy railway rates. To obtain the best market prices consignments should be large, not less than 100 tons of the same grade, in fact, a whole cargo of bulk grain on charter would get an advantage as it could be diverted to any port. Kenya will never compete with South Africa as regards area under cereals, as the former country will grow many more valuable crops.

WHEAT has been successfully grown but only to the extent of about 5000 acres, probably because of the liability of the plant to attacks of rust (*Puccinia graminis*), which in 1920 reduced the average yield to 3 bushels per acre. In 1920 also the Department of Agriculture sent the writer some seed wheat from two rust-resistant varieties which had been bred at the Kabete Experimental Station near Nairobi. One acre of each was grown at an altitude of 6800 feet and only a trace of rust was found, and a similar result was obtained the next year. The average yield would be about 15 bushels per acre.

BARLEY grows well and does not appear to be much attacked by rust, and the yield is higher than that of wheat. There should be a ready market in South Africa for barley, if transport could be arranged.

TEA. — The highlands of Kenya offer conditions of rainfall and soil which in many respects resemble the tea districts of Ceylon. Small areas have been planted and the quality of the tea appears to be satisfactory. An experimental 8 acres which came under the writer's notice showed that the total cost from clearing the ground to the first plucking in the 4th year, would be about £25 per acre. The great difficulty with this crop would be to maintain a supply of trained and fairly intelligent labour for which the African natives are not so well adapted as the Indian.

CITRUS FRUITS are very suitable for the highlands where the soil is of light texture and where the rainfall is heavy. The crop can be grown for the expression of the juice as a beverage, or for the production of citric acid, or for the essential oil. A small crop may be picked in the third year but the bushes will not be in full bearing until they are six years old. The necessary acreage is small, say 50 to 75 acres, and the labour needed is much less than for some crops, but capital is required for the presses in addition to that which must be expended before the productive stage is reached.

TOBACCO (*Nicotiana tabacum*). — Some years ago the cultivation of tobacco was tried in Kenya but the quality of the leaf was not satisfactory and although a tobacco officer is on the staff of the Department of Agriculture and experiments have been carried out by the Government, few

settlers have given attention to the crop. The plant requires a soil of open texture and with a high percentage of potash; chlorine is detrimental; phosphates favour early maturity and a light coloured leaf; excess of nitrogen produces coarse, heavy dark leaves. The plants are grown from seed and transplanted when 8 to 10 weeks old and about five weeks later are topped by nipping off the flower-bud and leaving 10 or 12 leaves on the stem; when ripe the leaves are removed, tied in bundles of three and hung over sticks and allowed to wilt in the sun, after which they are taken to the drying-barn where they remain for 6 or 7 days in temperatures rising at regular intervals from 90° F to 160° F. A drying-barn of simple construction measuring 20 × 20 × 20 feet will deal with 3 ½ tons of wet leaf, the product of 2 acres. The dried leaves are then carefully stacked on a wooden floor and left for 6 or 8 weeks to ferment and mature; during this stage butyric and acetic acids are produced and ammonia is evolved. The alkaloid content increases from 0.25 % in the young plant to 4 % or more when full grown. When mature the leaves are graded and placed in bundles or "hands" of 13 or 25 leaves, ready for packing and export.

There are many other plant products to which reference might be made, such as coconuts, rubber, wattle-bark and flower growing for perfumes, but those already mentioned are sufficient to give some idea of the possibilities as regards vegetable products of the Central and East African parts of the British Empire. The chief requirements of these countries are improved means of transport, and instruction of the native in modern methods of agriculture. Adequate funds and facilities should be placed at the disposal of the Departments of Agriculture so that the resources of science may be brought to bear on the many problems, in the interests of increased crop production.

359. Studies on Tobacco Cultivation and Curing in Italy.

I. — BENINCASA, M., Kentucky gigante. Un nuovo ibrido di tabacco Kentucky. *Bollettino Tecnico del R. Istituto Sperimentale per le coltivazioni dei tabacchi, Scafati (Salerno)*, Year XIX, Nos. 3-4, pp. 191-194, figs. 2, Scafati, 1922.

II. — VISINTINI G. Alcune cifre sulla coltivazione del tabacco e lavori inerenti. *L'Istria agricola*, Year II, No. 14, Parenzo, 1922.

III. — Quanto può rendere il tabacco. Confronti col granturco e col lino. *Bollettino della Cattedra Ambulante di Agricoltura per la provincia di Bergamo*, Year XVII, No. 8. Bergamo, 1922.

IV. — DONADONI, M. La nuova cura sistema Angeloni per i tabacchi tipo Kentucky e similari. *Bollettino tecnico del R. Istituto Sperimentale per la coltivazione dei Tabacchi, Scafati (Salerno)*, Year XIX, No. 2, pp. 73-80.

V. — DONADONI, M. Sulla probabile uguaglianza di quattro percentuali nella cura a fuoco diretto, e a foglie staccate del tabacco Kentucky. *Ibidem*, Nos. 3-4, pp. 205-214.

VI. — BERNARDINI, L. Sulla perdita in nicotina dei tabacchi in funzione dell'umidità e del calore. *Ibidem*, pp. 215-230, diagrams 2.

VII. — NOVELLI, N. L'industria degli essiccatori e la tabacchicoltura. *Il Giornale di Riscicoltura*, Vol. XIII, No. 2, pp. 18-20. Vercelli, 1923.

I. — In 1913, BENINCASA began selection work with a view to obtaining a heavy type of tobacco with a yield superior to Kentucky and its various hybrids of the heavier kinds, as already cultivated in Italy. He obtained the desired result by pollinating a cross between "Salento" and "Erzegovina gigantea" with pollen from the hybrid "Salento" (*Nicotiana glauca*) and further selection. To the type thus obtained he gave the name of "Kentucky gigante". Since it produced a number of leaves which was excessive from the industrial standpoint, this hybrid was re-crossed with pure Kentucky, raised from seed from the United States. The new type bore larger and fewer leaves and was given the name of Kentucky gigante No. 2.

This tobacco has a very high yield; almost before the floral buds appear, the plants have reached the height of about 2.3 m. It is suited to hot climates and cool, fairly heavy, fertile soils. Good "Toscani" cigars of the fermented type are made from the leaves.

II. Prof. VISENTINI has made a series of estimates of the amount of labour required in tobacco cultivation.

Planting. — In damp, loose soil without clods, 6 boys take 20 minutes to plant one plot of 4 rows each containing 250 plants; that is to say, a boy can put in about 500 plants an hour. In half-dried lumpy soil, recently watered, a boy will barely reach an average of 1880 plantings a day. It is too much to expect that a strong, expert man will plant 8000 seedlings, or a woman 6000 in an eight hours' day and 5000 is a very good average.

Gathering the leaves. — After a little instruction, 12 boys will gather 886 leaves per hour of the first crop (lower leaves) and 1088 of the second. The return, if women are employed, is less, the average being 722 leaves of the second crop per woman and per hour, as their movements are hindered by the sticky leaves which cling to their garments.

Sorting the leaves. — The largest amount of work is done with the leaves of the second crop of the Erzegovina variety; 1633 leaves being picked per woman, and 1175 per boy, per hour.

Stringing the leaves. — This is a operation especially suited to strong young women. A clever worker will thread 6000 leaves in 8 hours, but the average does not exceed 5000.

III. — From the data collected by the Brescia Travelling Professor of Agriculture, tobacco yields a higher gross and net return than any other crop. For purposes of comparison the two most profitable crops, maize, and flax were chosen.

The average production per hectare for the province is as follows: maize 36.8 quintals, flax 4.6 quintals of retted fibre and 7.7 quintals of seed; tobacco 15.3 quintals of leaves. Taking a moderate price standard (August 1922), the following estimates can be made; Maize 100 *lire* per quintal, flax-fibre 480 *lire* per quintal, linseed 190 *lire* per quintal; and tobacco 580 *lire* per quintal. Thus, the gross return per hectare for the

three crops is: 3680 *lire* from maize; 3681 *lire* from flax and 8874 *lire* from tobacco.

In the case of maize, it may be reckoned that a quarter of the crop goes to pay for the expenses of hoeing and harvesting; thus there remain 2760 *lire* for the owner who has to undertake the cost of working the ground, sowing and manuring.

In the case of flax, one-third of the produce suffices to pay for harvesting and handling, so that there remain about 2450 *lire* for the owner from which must be deducted the expenses of cultivation, manuring and sowing.

When tobacco is grown, the cultural operations, curing and sorting absorb one-third of the gross value of the produce. If reckoned at one-half to allow for the inexperience of novices in tobacco-growing, there is a balance of 4437 *lire* per hectare from which must be subtracted the expenses of working and manuring the land, etc. The profit is even higher, if it is remembered that tobacco may follow the second crop of hay and sometimes is even planted after wheat. A further advantage is that though tobacco cultivation requires more labour than the other crops there is always a large margin of profit.

IV. — The new curing method devised by ANGELONI for tobaccos of a heavy type includes the following successive operations: gathering the leaves — yellowing — pressing — partial drying — removal of the veins — partial drying of the leaves after removal of the veins — mass fermentation.

Yellowing is obtained by a heating process (ANGELONI has improved upon the ordinary method) by hanging out the strings of leaves or suspending the whole plant ("scaffolding"). The latter method is preferable (1).

The yellowed tobacco is passed into the cement presses where it is subjected to a uniform pressure for 24 hours. The leaves are then taken from the presses, spread out in the air to dry and then the veins are removed. The leaf fragments are again dried by being once more exposed to the air, or put into special desiccators and then kept for a day in the so-called re-fermentation receptacles (*panconcini*). Fermentation sets up in small masses that increase in volume after repeated turnings over. After two or three fermentations within a maximum period of 4 days, the required state of transformation is reached, the moisture content is then reduced to 25 % — slow fermentation takes place — the tobacco is made up into bundles and finally worked up.

With this system a workable product is obtained in ten days, but it cannot be rolled. Leaves for rolling must be specially selected for the

(1) This is confirmed by the work of Dr. L. BERNARDINI (sul nuovo processo ANGELONI di cura e fermentazione dei tabacchi tipo Kentucky, *Bollettino tecnico del R. Istituto Sperimentale, Scalfati*, Vol. XIX, Nos. 3-4, pp. 195-204, 1922), who has proved that spreading out the plants has the following advantages: 1) it is not necessary to dry the veinless leaf after pressing, provided its moisture does not exceed 50 %; 2) the development of the acid smell during fermentation and the consequent "fried" odour acquired in the manufacture are eliminated; 3) the fermented product has more substance and therefore keeps better.

purpose and either cured by the fire process, or by some modified form of the ANGELONI system. It is also necessary in this case to prolong the yellowing until the leaves begin to turn a brownish colour to limit the pressure, and to arrest the mass fermentation at the right point.

V. — DONADONI stated in 1912 that the weight of a tobacco of normal consistency *i. e.* a tobacco that has re-absorbed sufficient moisture after the curing to allow the leaves to be handled without danger of breaking, is very nearly the weight of the dry substance present in the same tobacco at the time the leaves were gathered. Afterwards, when working with Kentucky tobacco that had been cured after separating the leaves and by direct fire-heat, he found that in the average of a series of tests, the first of the two weights only exceeded the second by barely 0.5 %; a difference that may be attributable to the loss of volatile substances during the drying up of the specimen used for the determination of the dry matter.

Hence it follows that: the percentage of dry substances present in tobacco leaves at the moment they are gathered should be the same as the percentage of the same substances in cured tobacco of normal consistency; 2) the weight of the water in cured tobacco of normal consistency is equal to the weight of the dry matter lost during the curing process; 3) the moisture percentage in cured tobacco is equal to the percentage of dry matter lost during the curing process.

In the experiments he made from 1912 to 1922, the author found the general averages (in 12 samples) of the 4 percentages: dry substance in green leaves — dry matter in tobacco of normal consistency — loss of dry matter — moisture in cured tobacco — to be respectively: 15.49 — 15.55 — 15.92 — 16.96 %. Owing to the inevitable errors in such calculations, these figures may be regarded as theoretically equal, and this equality has been intuitively sought in practice. The average moisture content required for tobacco of the Kentucky type at the time of packing is not less than 15 % which, as a general average, is the percentage of the dry substances contained in the same tobacco when green, and of the dry substances lost during the curing process. In the case of the upper leaves of the plant, as much as 20-22 % of moisture is allowed, for it is only in the blades of these leaves that the amount of dry matter present at the time of gathering and lost during the curing reaches 20-22 %.

VI. — Dr. BERNARDINI has discovered among other facts that: 1) the losses of nicotine are largest in the moistest tobacco and are higher in tobaccos that have been fermented instead of merely cured; 2) the loss of nicotine through drying in the desiccator is almost wholly confined to the first 10 hours.

VII. — Prof. NOVELLI remarks that the technical institutions and the firms that manufacture desiccators in Italy have made continual improvements in these apparatus of which there are various excellent types, which are in increasing demand in the Italian rice-growing district. He also discusses the advantages of artificial tobacco drying and calls attention to some of the most important problems for the solution of which special experimental work is required.

F. D.

370. The Returns obtainable from a Cinchona Plantation in Java. (1)

I. — BERKHOUT, A. H., De rentabiliteit eener kinaonderneming. *De Indische Mercur*, Year XLV, No. 40, pp. 683-684. Amsterdam, 1922.

II. — VORSTELMANN, J. De rentabiliteit eener kinaonderneming. *Ibidem*, Year XLV, No. 50, pp. 859-860. Amsterdam, 1922.

III. — *Verslag omtrent de Gouvernements kinaonderneming de Tjinjoreaan (Bandoeng) over 1920*, pp. 1-56. figs. 2. Bandoeng.

The Government of Java has obtained very satisfactory returns of late years from its cinchona plantations, the profits realised being as follows in thousands of florins :

1917 — 1004	1920 — 1130
1918 — 249	1921 — 1229
1919 — 910	

(1 florin = 1 s. 53/64 d.)

The total area under cinchona is 1454 "bouw" (about 1000 hectares) so that the annual profit per "bouw" was about 600 florins. The capital at the end of the year was 800 000 florins.

The Government Authorities connected with the cinchona plantations have always encouraged private enterprise, so that at the present time, there are several plantations belonging to private owners. If cinchona growing had from the beginning been in the hands of private companies it would not, however, have been possible for Java to have obtained the world monopoly of cinchona that she at present possesses, and which is largely due to the fact that the Chamber of Deputies has not the power to liquidate the plantations in bad seasons. As soon as the returns reached 120 000 florins per "bouw", the Government reaped the reward of their perseverance. On account of over-production, 1892-1896 were bad years, the profits obtained being $\frac{1}{100}$ of those secured from 1917-1921. Many private plantations could not survive this crisis. After the War, many tea and coffee planters who were doing badly began to grow cinchona. The market for quinine is limited; during the War, the demand for this drug greatly increased, but at present, the supply exceeds the demand.

By reducing production, however, the planter could still get high prices. This reduction has been effected, not by retrenching the area under cultivation, but by felling fewer cinchona trees. The remaining trees, as they grow, increase the future supply of quinine, so that in the event of the demand increasing, it can be met from these trees, whereas new plantations do not become profitable for 10 to 20 years. As however, it is probable that the demand for quinine will not increase, care must be taken not to produce within the next few years a crisis similar to that of 1892-96. Measures should therefore be taken at once to avert the danger. In critical times, it is important for the cinchona bark to have a high quinine content. It may be assumed that the gathering drying, packing, transport to Amsterdam and sale expenses of 1 kg. of quinine amount to 10 cents (Dutch). When

(1) See: J. VAN BREDÁ DE HAAN, *Cinchona Cultivation in Java*, R. Nov. 1915, pp. 1531-1536. (Ed.)

the unit (price per percentage of sulphate of quinine per half kg.), is 2 cents the return of 3 % bark will be $3 \times 2 \times 2 = 12$ cents per kg., and the profit will amount to 2 cents. A 6 % bark gives a surplus of $6 \times 2 \times 2$ cents — 10 cents \times 14 cents, that is to say, 7 times more than a 3 % bark.

If the "unit" is 8 cents the ratio of the net returns from 3 % and 6 % barks is only 1 : 3.

A net return of 2 cents per unit is not enough to cover all the general expenses and wages bill which are over 20 cents per kg. Thus, with a unit of 2 cents, the expenses are only met by a bark with an average 8 % quinine sulphate content.

According to VORSTELMANN (II), no exact comparison can be made between the Government plantations and private plantations, since the owners of the latter have, amongst other things, to consider the question of taxes. VORSTELMANN obtained his data from the reports of private plantations, and found that the expense of sending 1 kg. of bark from Java to Amsterdam was about 59 cents instead of 20 cents. With a unit price of 2 cents and a bark containing 8 % of sulphate of quinine, the expenses would not be covered, and the planter would be obliged to add 27 cents. The author says that the expenses of a good plantation are generally assumed to be covered when the price of the unit is 6 cents. The average sulphate of quinine content of the Javan crop is about 5 %, which gives a return of $2 \times 5 \times 6 = 60$ cents per kg.

BERKHOUT alludes to grafts and states that the offspring of parent trees with a high quinine content are not always equally rich in quinine; further, the development and resistance of the trees must always be taken into account.

The age of the trees is also a very important question in cinchona cultivation, for after a certain age, the quinine content begins to decrease. The following figures come from the 1903 report of the Government plantation. Average quinine content of trees of different ages:

1 year, 2.5 %; 2 years 7 %; 3 years, 9.5 %; 4 years, 10.7 %; 5 years, 10.8 %; 6 years, 10.4 %; 7 years 10.3 %; 8 years, 9.7 %; 9 years 9.5 %; 10 years, 9.3 %; 11 years 9.5 %; 12 years 9.2 %; 13 years 9 %; 14 years 8.4 %; 15 years 8.3 %; 16 years 8.2 %.

It may therefore be considered that the percentage increases up to the fifth year, and then remains constant for a time, after which it decreases. The author also quotes data from many similar tables (According to VORSTELMANN (II), it is generally assumed that a decrease in quinine content sets in after the eighth year, but there are exceptions to this rule).

Two systems of working cinchona plantations are employed in Java.

The first consists in cutting down all the trees of a certain lot as soon as they have reached a given age, and replanting the ground the same year. In the second system, only some of the trees are cut down here and there, but young individuals are at once put in their place. It must not, however, be supposed that any trees can be removed as soon as they have attained their maximum quinine content, on the contrary, a system of rotation must be carefully observed:

Example : —

Age	Sulphate of quinine production per " bouw " (76.3 sq ft.)	Age	Sulphate of quinine production per " bouw " (76.3 sq ft.)
years	kg.	years	kg.
3.	16	8	49
4.	24	9	53
5.	32	10	57
6.	38	11	61
7.	44	12	65
		13	69

Total 508 kg.

Assuming that the plantation has been treated systematically, and that owing to good management, the amount of bark at a certain age is equal to the sum of the products of all the earlier clearings, then with an 8 years rotation on an area of 208 " bouw ", there will be 26 " bouws " of one year old trees, and the same number of " bouws " with two, and three, year-old trees respectively etc., whereas the trees will have been uprooted on 26 " bouws ". The total crops in this case will be : $16 + 24 + 32 + 38 + 44 + 49 + 53 + 57 + 61 + 65 + 69$ kg. $\times 26 = 10\,556$ kg. per annum.

By modifying the rotation, so as to have 13 lots each of 16 " bouws ", bearing trees 1, 2, 3 etc. years old, the trees on 16 " bouws " could be uprooted every 16 years, and 16 " bouws " of trees 3 years old and the same number of " bouws " of trees 4 years old could be thinned. The total annual crop would therefore be 16×508 kg. from thinnings, and the same amount from uprooting, which would mean 16.256 kg. viz. over 50 % more than in the first case.

This calculation has been made with the object of proving that a scientific choice of rotation considerably increases the crop without however increasing the up-keep expenses. Probably the best rotation is one of more than 20 years.

Young planters can draw useful conclusions from these figures, but in order for them to be able to compete with their older colleagues, they will need to possess sufficient means to enable them to wait until their plantations attain a considerable age.

In the author's opinion, the second system of managing the plantations is less to be recommended, as its control is far more difficult.

The author's conclusions are that :

- 1) The average quinine content has tended to decrease of recent years.
- 2) Bark production increased greatly from 1893 to 1897.
- 3) No increase has been recorded of late years.
- 4) It is the duty of the Experiment Station to study thoroughly the question of the decline, and the means by which it may be remedied.

D. V. S.

371. The Olive-Tree in French North Africa.

I. — CORCELLE, A. (Directeur de la Société Industrielle de l'Afrique du Nord). L'Olivier dans l'Afrique du Nord. *Bulletin des Matières Grasses*, No. 5, pp. 127-130. Marseilles, 1922.

II. — REGIS, E. (Fabricant d'huiles). Le Commerce et l'Industrie des Matières Grasses. *Ibidem*, No. 7, pp. 161-173, 1922.

III. — DUBOULOZ. L'Oléiculture in Algérie. *Mémoires et Rapports sur les Matières Grasses*, pp. 137-144, Institut Colonial, Marseilles, 1922.

IV. — ESTESSE (Chef dy Service de l'Agriculture au Maroc). La Culture des Oléagineux au Maroc. *Ibidem*, pp. 59-74, 1922.

V. — RUBY J. (Directeur des Services Agricoles des Bouches-du-Rhône). L'Olivier au Maroc. *L'Agronomie Coloniale*, Year 8, pp. 73-85. Paris, 1922.

VI. — TOURNIEROUX (Ingénieur agricole). L'Oléiculture en Tunisie. *Bulletin de la Direction Générale de l'Agriculture, du Commerce et de l'Industrie*. Year 26, No. 109, pp. 19-169, tables, figs. 74. Tunis, 1922.

I. — The olive-tree is cultivated throughout French North Africa on a zone 80 km. wide, extending along the coast from Syria to South Morocco, but large stands are only found in certain regions and chiefly in the mountainous districts. Olive-growing dates back to remote antiquity, and the wild olive-tree is indigenous to this part of Africa; there are therefore a number of local varieties, which have, however, never been botanically classified.

In all parts of the country there are countless wild olive-trees, in some cases forming regular forests, that only need grafting in order to become a source of wealth. Grafting has already been carried out in Kabylia with excellent results, but elsewhere, although the natives are zealous cultivators of the olive, they know nothing about grafting and at the present time, olive-trees are nearly always propagated by the tedious process of cuttings. Attempts have, however, been made to rejuvenate the oliveyards by means of shoots growing out of old trunks cut down level with the ground and by planting large roots of old trees. In these methods, thick branches and fruit have been obtained after three or four years.

The condition of the olive-plantations varies, according to different districts; in some places, old trees bearing little fruit are found, while in others, there are young well irrigated and well-worked olive-yards with a constantly increasing yield.

In many parts, olive-trees are grown in the vineyards where they profit to a certain extent from the care given to the vines, but their fruit under such conditions, although large, has a low oil content and is therefore chiefly suited for preserving.

The olive-trees bear every other year only, on account of the practice of knocking down the olives with a pole. The crop is harvested from November to the end of January. In order to save the expense of keeping the fruit, the Arabs are inclined to gather the olives before they change colour with the result that 4 % of the oil is lost; it is therefore desirable that the Authorities should regulate the time of harvesting.

The natives have the idea that they can obtain the best yield of oil

by piling up the olives in heaps and allowing them to become heated, the results being rancid oils with an oleic acid content of 7 to 8 %. The Arabs however, prefer oils with a strong taste and the practice of keeping the olives in this manner is general, except in Tunisia, Kabylia and Sieg where they are grown for export.

The average industrial yield of North African olives is 16 %, the maximum being 22 % for the olives cultivated on the slopes, and gathered in January, when their skins are already shrivelled, and a minimum of 11 % for vineyard olives. The wild olives are the poorest, and only contain 5 % of oil.

The old, native olive-presses have nearly all disappeared, their place being taken everywhere, except in Morocco, by hydraulic presses which have so largely increased in number, that there are now not enough olives to supply them, hence the competition is very keen and their economic position is highly unsatisfactory.

Olive-oil residues are now everywhere sold at good prices to local extraction factories, they fetch as much on the spot as at Marseilles, though in Morocco they sell at an even higher price for fuel.

It is worth remarking, that except in Argan, North Africa possesses no oleiferous plant except the olive-tree.

ALGERIA. — The author estimates that the Algerian oil production varies around 400 000 quintals, the chief centres being Kabylia, the environs of St. Denis-du-Sieg and the neighbourhood of Tlemcen. It is almost certain that most of the olive-trees cultivated by the natives in Kabylia are old grafted specimens.

II. — The author reckons that the country exported 5600 tons of olive-oil before the war. Since then, the local consumption has increased, and Algeria now uses all its own production of olive-oil, and also imports considerable quantities of pea-nut oil from France.

In Greater Kabylia, large factories have already been started. In addition to the 65 000 hectares under olive-trees in full bearing, there are estimated to be 320 000 hectares of forests, and land covered with brush-wood, including wild olive-trees, which could be planted.

III. — The author remarks that care should be taken not to make large olive-yards, for as labour is scarce at the time the crop is ripe, olive-growing must remain a domestic industry. Stock should never be allowed to graze in the olive plantations, since a herd of goats can destroy hundreds of young scions in a few hours, the grafts withering as soon as they are injured. Instead of uprooting wild olive-trees in order to plant Aleppo pines in their place under the pretext of re-afforestation, it would be preferable to graft or replace the wild olive-trees with good varieties.

IV. MOROCCO. — The author considers that Morocco will need to develop its olive cultivation considerably in order to keep pace with its own requirements.

The following quantities of olive oil, most of which came from Spain, were imported :

688 369 kg. in	1915
1 273 876 " "	1917
174 080 " "	1918
1 189 381 " "	1919

The country is extremely promising for development as regards the olive-oil industry. The number of olive-trees shown in the last census return was 2 167 637. The best olive-growing districts are Fez, Marrakech and Meknès. The above figure does not include the olive-trees in the heart of the Atlas Mts. which have not yet been counted, though they are known to be very numerous.

Before the French occupation, the natives used to fell the olive-trees, but this abuse has been stopped by law, and in order to encourage planting, no tax is levied upon the trees for the first 20 years after plantation. Prizes are also given for planting and grafting, with the result that 36 875 olive-trees were planted, mostly by natives, during the 3 winter months of 1921-22.

The condition of the olive-yards leaves much to be desired, for the trees are too close together (3.50 m.), the fruit is always knocked down with poles, etc. The natives, however, are glad to listen to the members of advisory corps which is being formed by the Agricultural Authority.

At the present time, the annual average yield per tree in the unirrigated regions of the North may be estimated at 12-15 kg. On irrigated land, near Marrakech, the average figure is 20 kg., and the gross production may be as high as 40 kg. For the suppression of theft, regulations are made for the olive-gathering, except in the region of Marrakech. The crop is gathered in November and often proves insufficient to supply the few modern oil-factories started in Morocco which find their whole output absorbed by the local consumption. On the other hand the olive oil residue industry, has every chance of success in the country, as olive-pomace is often used for burning owing to the scarcity of fuel, and fetches 25 to 80 fr. per ton at the mills.

V. — In the first part of his paper, the author describes the different varieties of olive-tree to be found in Morocco. He also gives an account of the present condition of olive-cultivation and of olive-oil manufacture in the country.

The number of olive-trees may be estimated at 2 500 000, and their average annual yield at 20-25 kg. of olives; thus giving for the whole country 500 000 to 600 000 quintals, of which nine-tenths go to the oil-factories. Allowing for the low output of the native mills, the annual production of oil may be reckoned at 60 000 to 70 000 quintals.

OLIVE PLANTATIONS OF THE SOUTH. MARRAKECH DISTRICT. — At Marrakech, there are in the Kénara garden, and the Experiment and Demonstration Field, 7000 magnificent olive-trees growing on deep, regularly irrigated alluvial soil and profiting by the care bestowed on the crops at their feet. They have attained the height of 10-12 ft., but are unfortunately too closely planted, being only 7-8 m. apart.

In the rest of the country, there are 800 000 olive-trees distributed amongst isolated olive-plantations each containing from a few hundred to some tens of thousands of trees. The olive-trees are always irrigated here, the water used for the purpose being either obtained from the subterranean springs by the system of the *rétaras* or else from the *séguia* coming from the *oueds* which are fed by the snows of the Atlas Mountains.

A single variety is mainly grown in all these plantations. Propagation is effected by slips, and there are no traces of grafting. In a hole 0.60 m. in diameter and depth, three cuttings from 0.03 m. to 0.05 m. in diameter, and 0.50 m. to 0.60 m. in length are planted, and covered with earth to within 0.03 m. or 0.04 m. of the top. The cuttings are planted out either from November-December, or else from March-April. They are watered from the time with due regard to the need and amount of the water at disposal. The trees begin to bear about their fifth year. They do not suffer in any way from the presence of cover-crops, such as cereals, beans and winter forage, as these are well tended. The only diseases that have been reported are the olive-tree canker (*Bacillus oleae*) and the olive-fly (*Dacus oleae*) though both are very rare. In the best years, the trees, produce 80 to 120 kg. of olives, but in bad seasons, the crop is almost negligible; it may be estimated at 30-50 kg. in the case of regularly irrigated trees.

OLIVE PLANTATIONS OF THE NORTH DISTRICT OF MEKNÈS AND FEZ. — The trees are planted at intervals of 5 to 10 m. Few new plantations are made, and in every case they are planted with single cuttings which are after 12 to 15 years, in order to give space to the young olive-trees.,

After the crop is gathered, the natives very frequently scrape the soil. Semi-circular basins, often containing dung or olive-residues, are made at the foot of each tree to catch the irrigation water. Pruning is no longer practised, and even the shoots of the trunk which are browsed upon by live-stock are not cut off. Excellent results can be obtained by irrigation, but even unirrigated plantations, those of Zerhoun for instance, do not show the signs of degeneration, which are observed in the south.

In the region of Meknès, all the parasites of the olive-tree known in Europe are to be found, scale insects, *Dacus oleae*, and the mining caterpillar (*Prays oleae*). Fumagine is regarded as the most formidable disease.

The yields are lower in Meknès than in the district of Marrakech on account of the smaller size of the trees, the frequent want of irrigation, and parasitic infestation. The average annual yield per tree may be estimated at 10-20 kg. of olives.

VI. TUNISIA. — The author has written a very complete study of olive-growing in Tunisia, in which the following questions are considered: Olive cultivation in Tunisia during the Roman period and at the present day; the olive-oils of Tunisia; the cultivation of the olive-tree (soils, propagation, plantation making, cultural operations, pruning, irrigation, manuring, fructification, harvesting, sale price of olives, yield and cost varieties, cover-crops, methods of planting, organisation of an estate, stands of wild olive-trees, preserved olives); the enemies and diseases and other risks of the olive-tree; Tunisian laws for the regulation of the olive-growing industry.

The industry was very prosperous under Roman rule, and since 1881, it has again been greatly developed, 4 000 000 olive-trees having been planted since this date on 14 500 hectares. The total number of trees thus obtained is 12 563 000 of which 10 155 000 are in bearing.

The Northern district has 3 600 000 trees, but they are mostly old specimens growing in irregular plantations, many of which are pulled up for use as fuel. On good soil, the olive-tree is obliged to yield precedence to cereal crops.

Vast works have been carried out in Sahel in order to reclaim and provide water for the dry hillsides. This district already possesses 4 000 000 olive-trees, and the native are so much interested that it is certain that all the land suitable for the purpose will soon be planted with olives.

In the Sfax district, the soil is deep and siliceous and well suited to olive-trees. The number of trees was 380 000 in 1810, but has now risen to over 3 000 000 owing to the enterprise of French planters. Nearly 2 000 000 trees will, however, not reach their maximum yield before 1930-1940. Excellent plantations are to be seen composed of trees set in squares with wide spacing (20-24) and in straight lines, each individual being well pruned and maintained. All the old plantations have been gradually cut down as the trees died. The natives are so anxious to make new plantations, that the authorities are obliged to restrain their ardour, in order that there may not be too sudden a change in the equilibrium between the land under olives and the area devoted to the cultivation of cereals and the grazing of the travelling flocks of sheep.

In the CENTRE, the soils are either siliceous similar to those of Sfax, and therefore very suited to olive-trees, or else they are very dry and require irrigation. Olive cultivation was a very prosperous industry under Roman rule, but was afterwards abandoned in this district, good crops have, however, been obtained lately from some young plantations, although their development will certainly be delayed owing to the cost of well-construction and the character of the inhabitants, who are incapable of any sustained effort.

THE SOUTH. — The soil in the extreme South also resembles that of Sfax, but owing to the hot, dry climate, it needs irrigation. The possibilities of the country are well seen in the forest of Djerba with its 900 000 old, unirrigated trees, and in the flourishing young plantations of 200 000 trees at Zarzis and Ben Gardane. There is no doubt that with adequate means of irrigation, the natives could succeed in growing olives wherever Roman civilisation has left its traces in the district.

The amount of olive-oil exported by Tunisia before the War, was in the neighbourhood of 100 000 quintals. In 1917 and 1919, it rose to 235 000 and 219 000 quintals respectively, as the young plantations especially those of Sfax, had by that time come into bearing and furnished an appreciable supply of olives.

The oils of the North are fruity and highly-coloured. Those of Sahel are somewhat inferior in both these respects resembling more nearly the oils of Bari to which place, they are actually exported.

The Sfax oils are slightly fruity and are much liked by the general public in France. Unfortunately, they coagulate even more readily than those above mentioned.

Tunisia possess numerous modern oil-factories, and 7 factories for the treatment of the olive-oil residues.

No over-production need however be feared in the near future, for olive-cultivation is in fact stationary or retrograde, in the districts where it is most developed. Olive-oil is also in increasing demand and much preferred to seed-oil. Since olive-trees only do well in Tunisia on poor soils and considerably increase their value, for instance in the Sfax region, land used for grazing travelling flocks was worth 40 fr. per hectare in 1914 and at the same date, similar land under olive-trees in bearing was valued at 850 to 1700 fr. per hectare, it may be said that the economic conditions of olive-growing in the country are eminently satisfactory (1).

R. D.

Crops.

372. The Distribution of Varieties of Wheat in France.

BRETIGNIÈRE, L. *Revue de Botanique appliquée et d'Agriculture coloniale*. Bulletin No. 16, pp. 785-792, 2 maps. Paris, 1922.

The differences in the climate in the various parts of France long ago necessitated types of wheat suited to local conditions. These "blés de pays" still occupy 1 800 000 hectares of the land under cereals and include *Blanc de Flandre*, *Barbu de Champagne* and the Alsatian varieties (Seille and Altkirch). In the S-S.E., types of wheat with tapering ears are met with. The South-Eastern varieties (*Saizettes*, *Tuzelles*) are drought resistant. *Blé de Roussillon*, which is grown on poor land exposed to scald, is replaced by *Bladettes* and *Blancs* in the basin of the Garonne, wherever the conditions are more favourable. In the poor regions of the Massif Central, a wheat similar to Roussillon is cultivated. Throughout nearly the whole of Brittany and Normandy and in the Paris basin, the improved wheats have been substituted for *Franco Blés à barbes* (awned) and *Chicots sans barbes* (awnless).

Since 1830 Spanish, Italian and Russian wheats have been increasingly cultivated on the plains of South and Central France, but their extension is checked by the cold, although *Blé bleu*, or *Blé de Noël* can thrive as far as Beauce, and one variety, *Gros bleu*, is still grown largely in the Centre. In the middle of the XIX century English wheats gained a footing on account of their dense ears and stiff straw, and were grown in the North and North-West of France. Now, however, their sole representative is *Goldendrop*, a variety that is only suited to poor soils and cold climates, and *Wilhelmina*, a wheat suitable for cool, fertile soils of districts with a maritime climate.

At the end of last century, Henry de VILMORIN obtained many new types by crossing. *Bon Fermier* and *Hâti Inversable* are well-known in all parts of the country where the soil is rich, and cover 1 200 000 hectares. *Dattel* has maintained its position in the North, as has *Trésor* where the

(1) As regards the Italian Colonies see: Passé et Avenir de la culture de l'olivier en Lybie. *Bulletin de la Direction Générale de l'Agriculture, du Commerce et de l'Industrie*. Tunis, May 1917, pp. 68-70. (Ed.)

FIG. 81.

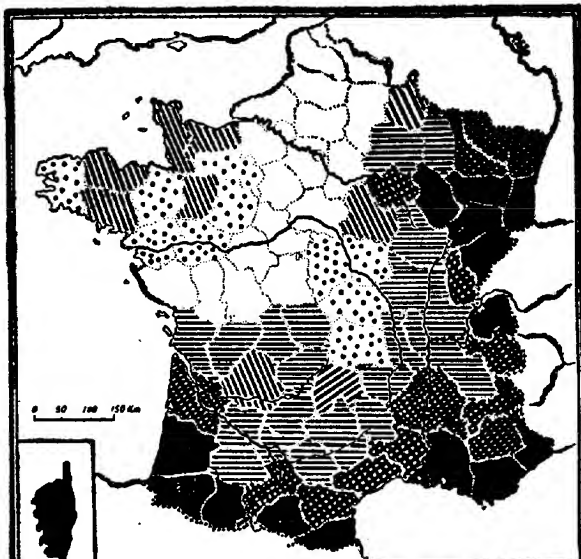


FIG. 82.

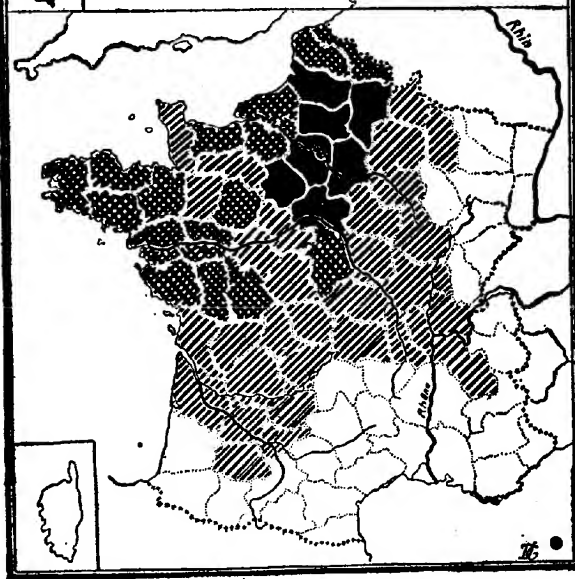


FIG. 81. — Distribution of the varieties of wheat in % of area under wheat in France: White: below 10 %; Dotted: 10 to 25 %; Diagonally shaded: 25 to 30 %; Horizontally shaded 30 to 75 %; Cross-hatched 75 to 90 %; Black: above 90 %.

FIG. 82. — Distribution of the varieties, *Bon Fermier* and *Hâtif Inversable* in % of area under wheat: White: below 10 %; Shaded: 10 to 25 %; Cross-hatched 25 to 30 %; Black: above 30 %.

land is fairly fertile. *Japhet*, grown in the polders of Mont St. Michel is, on account of its high yield a favourite in the West, Centre and South-East of France, while in the North, it is cultivated as a February wheat. Finally in 1917, 1920 and 1922, VILMORIN created other varieties *Alliés Paix* and *Vilmorin 22* which will doubtless be largely grown.

The cereal-breeders of France have tried to obtain by means of crossing, varieties of wheat adapted to the different regions.

DENAÏFFE, in the East, has created cold-resistant types, while BRNOIST has produced, at Beauce, varieties suitable for rich soils. The Alsatian wheats have also been improved, and in this way, *Colmar* and the Jurassic varieties have been obtained. However the general use of these wheats is not to be recommended, as it is preferable to start again from local types. Thus, near Valence, the *Saisettes* are being studied, whereas elsewhere, different varieties of Italian wheats (*Carlotta Strampelli* and *Rieti*) are the objects of research. In the South-West, where resistance to scald and wind are the chief characters sought, *Beplas* is taken as a starting point.

Some March wheats grown in the North (*Chiddam*, *Saumur Manitoba*, *Marquis* and *Aurore*) do well in the South-East, if sown very late in the autumn.

From an enquiry made in 1912, the *Blés de Pays* were found to be in complete regression, therefore if the climatic variations in France do not allow of the general use there of wheats with dense ears and very high yield, it is necessary to propagate improved, early-maturing varieties adapted to the conditions found in that country. (See Fig. 81 and 82.)

R. D.

373. Experiments with Varieties of Rice introduced into Spain.

GONZALEZ, J. Ensayos de germinación des arroces. *Estación central de Ensayo de Semillas. La Moncloa. Madrid, Boletín trimestral* Year II, No. 7, p. 11. Madrid, 1922.

The "Estación Arrocería del Delta del Ebro" (Tortosa) has directed the Seed Testing Station at Moncloa (Madrid) to make germination tests with 37 varieties of rice collected from the 1922 crop. The results should permit a selection to be made of varieties suitable for the existing climatic conditions.

With the exception of two varieties giving negative results ("skiro wasque" and "lencino", which showed a germination capacity of only 11.6 and 18 % respectively) and of three medium varieties (60 to 65.3 % germination), all the rest gave satisfactory results. Above 90 % germinating capacity are included: "amonquili" 90.3, — "ostiglia" 90.6 — "kitakawa" 91.0 — "joi ruski" 93.0 — "bulverano" 93.6 — "onsen" 93.6 — "seikaihoi" 94.3 — "originario 3" 95.6 — "takatzu" 95.6 — "bomba" 96.0.

F. D.

374. The Lesser Cereals.

CHEVALIER A, Les petites céréales. *Revue de Botanique appliquée et d'Agriculture Coloniale*, Vol. II, No. 14, pp. 544-550. Paris 1922.

The author applies the term "small cereals" to certain gramineae which either in their wild, or cultivated condition have afforded sustenance to man, although they are of less importance than the cereals usually grown for food. The yield of these gramineae is low, but they thrive on poor land requiring little preparation and will grow on a very thin layer of vegetable mould and on soils where no other cultivated crops can exist. As these unexact plants require the minimum of attention, they were cultivated in very ancient times, probably long before the cereals properly so-called. In the most remote ages man used the seeds of these wild gramineae as a food. In times of famine the fruits of the bamboo are eaten in British India, while in Central Africa, the author has seen tribes, such as the Bagnirmi, the Kotoko, etc. eat large quantities of the fruits of small, wild cereals.

In the centre, as well as on the borders, of the Sahara, the seeds of *Panicum turgidum* Fotsk. are eaten in seasons of dearth, the grain being obtained from deposits made in the sand by ants.

In the basin of the Tchad, the various gramineae used for food are known among the Bagnirmi under the name of Krebs. The chief species thus employed are: *Panicum Kotschyannum* Hochst., *Eleusine indica* Gaertn., *Dactyloctenium aegyptiacum* Willd. and some species of *Digitaria* and of *Setaria*. Possibly they were all once cultivated, but now they rank among the protected semi-cultivated plants.

In tropical Asia, *Panicum crus-galli* L. and *Panicum colonum* L. are used for food; while in Europe, the grain of *Digitaria sanguinalis* Willd. is gathered and made into bread, especially in Poland. *Digit. sang.* may perhaps have been one of the lesser gramineae earliest cultivated during the Neolithic Age. F. HOOKER states that it is still grown in Khasia (British India).

In South America, the Indians of Peru collect the seeds of *Milium paradox* Nutt. which they crush and make into flour and beer.

The following 12 principal species of lesser cereals are known:

I. — *Panicum spicatum* Willd., *Holcus spicatus* L., *Pennisetum Syphoidem* Lank. and the "petit mil," or "mil chandelle" of the French African colonies which is known in British India as "Lanion," "Bambaras," "Bubrush," "Bajra," or Bairj. This plant is believed to be a native of tropical Africa, but is no longer found wild there. It is, however, extensively cultivated throughout the Sudan, in Sahel, North Africa, Egypt, Madagascar, Angola, and South Africa, while in British India, it is one of the most widely-grown cereals.

II. — *Setaria italica* (L.) Pall. — *Panicum italicum* L. — *P. glomeratum* Moench. — *P. germanicum* Willd. — *Pennisetum italicum* R. Br. — *Setaria germanica* P. Beauv. The latter is considered by some botanists to be a cultural form of *S. viridis* Pall; it is the "miglio," or "milio degli uccelli" of Italy, and in France, it is called "panouil," "moha,"

"millet de Hongrie"; in British India it passes by the names of "Kangai", "Kanku", "Chena" etc. This millet is said to have been indigenous in China and Japan whence its cultivation has extended westward, for it is now grown in France (the Mediterranean region and the Pyrenees), in Germany and Bohemia, as well as in Italy, where several varieties distinguished by the colour of their seeds are known (*S. violacea* Horn., *S. flavida* Horn., *S. erythrosperma* Horn.). It is also widely cultivated in British India, Persia, China, Japan, the Philippines, Malaya, and by the inhabitants of the Mountains of Indo-China. This species of millet was introduced a long time ago into America and also into South Africa, where it is called "Boer Manna".

III. — *Phalaris canariensis* L. = *Ph. ovata* Monob., this plant is not to be confused with *Ph. sativa* Pers. which belongs to the genus *Phleum*. *Ph. canariensis* is also known as Canary-seed, and "scagliola"; the French call it "Alpiste" "Millet long", "Escayol", "Mil des Canaries". It is supposed to be a native of the Canary Isles and of the Iberian Peninsula, and is possibly derived from *Ph. brachystachys* which grows wild in the Mediterranean region. *Ph. canariensis* is cultivated here and there in France and in Corsica, Italy, Spain, North Africa, the Canary Isles and North-west India Morocco is however, the country where it is chiefly grown.

IV. — *Panicum miliaceum* L. = *Milium esculentum* Moench. = *M. Panicum* Mill. This is the common millet called by the French, "Mil en branches", "Mille", "Millet rond", "Mil de l'Inde", "Graine de Canarie". In British India, it goes by the name of "Chena Chin Sphikai". Two varieties are distinguished "phikai" and "rali". It is supposed that this cereal came originally from Egypt, or Arabia; THELLUNG thinks it is also a native of Central Asia. *Pan. miliaceum* is grown in South France and North Africa and is extensively cultivated in temperate and tropical Asia (British India and China), and is raised on a small scale by the mountain-dwellers of Indo-China.

V. — *Panicum miliare* Lank. Small millet, known in British India as: "Sava", "Kung", "Kutki", and "Chika". It greatly resembles the preceding species, but has smaller seeds. Some botanists regard it as the cultivated form of *P. psilopodium* Trim., a wild millet found in India, Burma and the Malay Peninsula. This species is cultivated only in British India and Ceylon, and perhaps also in Central China.

VI. — *Panicum frumentaceum* Roseb. (not Salisb.). This species is often regarded as a variety of *P. Crus-galli* L. Its synonyms are: *P. grossum* L. — *P. segelale* Herb. Roxb. — *Echinochloa frumentacea* Link — *Oplismenus frumentaceus* Kuntk.

In British India, where it is widely cultivated, this cereal goes by the names of "Shama", "Shamalu", "Mandira", or "Banti." It is also grown in China. ROXBURGH believes this form to be derived from *P. hispidulum* Roxb. which is merely a variety of *P. Crus-galli*. Most authors consider that *P. frumentaceum* possesses character intermediate between those of *P. Crus-galli* L. and *P. Colanum* L. The latter is a ubiquitous

species cultivated in the Punjab, according to WALT, for its seed and known by the names of "Savank", or "Wundu".

VII. — *Panicum esculentum* v. R. Br. possibly a variety of the preceding; it is cultivated in Japan.

VIII. — *Paspalum scrobiculatum* L. = *P. Commersonii* Lank = *P. frumentaceum* Retz = *P. hirsutum* Retz = *P. Kora* Wild.

This cereal grows wild in all hot regions and is cultivated in British India where it bears the names of "Kodra", "Kodo" and "Kodam", and covers many million acres. According to WATT, the seeds of some of its varieties contain a toxic principle.

Pan. scrobiculatum is much used as a forage plant.

IX. — *Digitaria exilis* (Kipp.) Stapf. = *Paspalum exile* Kippist = *Pasp. longiflorum* Franchs, Chev. (not Retz). A species very nearly related to *Dig. longiflora* Pers.

This plant is extensively cultivated by the natives of West Africa (French Guinea, Sierra Leone, French Sudan, Upper Volta, and North Nigeria). It is the smallest cereal known, since its height never exceeds 10 cm., and its seeds are minute. It will grow on any soil, provided the annual rainfall is not less than 80 cm. There are many varieties of *Digitaria exilis* and in the territories of Fouta Djallon and of the Upper Niger, this cereal is the chief crop and the staple food of the natives.

X. — *Eragrostis abyssinica* Link = *Poa abyssinica* Jacq. = *Panicum Tef* Dey. A plant known to the natives of Abyssinia under the name of Tef and derived from *E. pilosa* (L.) Pall. This cereal is much grown in the mountainous districts of Abyssinia and especially in the neighbourhood of Galla. It has also been reported from Upper Egypt and Nubia. It was introduced into South Africa as a forage plant and in Rhodesia produces about 2 tons of forage per acre. *Erag. abyssinica* is cultivated in Europe as an ornamental plant and has become semi-wild.

XI. — *Eleusine Coracana* Gaertn. = *E. cerealis* Salisb. This plant, which the colonists call "Coracan", or "Eleusine", is known in India as "Ragi", or "Makra". It is the cereal most extensively cultivated in India where it annually covers an area of 7 million acres and yields about 400 lb. per acre.

Eleusine Coracana is believed to be derived from *E. indica* a wide-ranging species found wild, or acclimatised, in all the tropical and temperate regions of the world. Two sub-species are to be distinguished: *E. stricta* Roxb. cultivated in India, and *E. Tocusso* Fres. grown in Abyssinia. *Eleusine Coracana* is cultivated not only in India, but, also in Ceylon, Madagascar, a large part of the Belgian Congo, in Ubangi and Chari. The flour made from it is used as a food, and also in the manufacture of beer. In East Africa, this cereal is grown from Upper Egypt to Mozambique; it has also been introduced into America.

XII. — *Coix Lacryma-Jobi* L., var. *Ma-Yuen* Stapf. *Coix Lacryma-Jobi* has been acclimatised in all parts of the globe, but only one (*Ma-Yuen*) out of its many varieties is cultivated as a cereal. This is grown in Sikkim, Khasia, India, Burma, China, the Philippines and Indo-China. In Japan it is said to be cultivated for making beer, while

in the Philippines, where it goes by the name of "Adlay", it furnishes according to P. J. WEBSTER (*Philip. Agric. Review*, 1921, p. 159) a nutritious and agreeable food having a higher nutritive value than wheat. It is used mixed with $\frac{1}{3}$ or $\frac{1}{2}$ of wheat flour. WEBSTER is of opinion that if the cost of producing "Ma-Yuen" could be reduced and the quality of its grain improved, it might be cultivated, at all events in the Philippines, in the place of rice; it would grow well in North Africa and throughout the Mediterranean region. F. C.

375. Nutritive value of Dawa-dawa Pods from *Parkia* sp. on the Gold Coast.

Bulletin of the Imperial Institute. Vol. XX, No. 4, pp 461-463. London, 1922.

The seeds of the dawa-dawa (*Parkia filicoidea*?), the leguminous tree common throughout the northern territories of the Gold Coast are used by the natives as a food. On analyses of pods at the Imperial Institute, London, it was found that both the powdery material in which the seeds are embedded, and also the seeds, though different in character are both of satisfactory composition as foodstuff. The powdery material is of value owing to its richness in carbohydrates, (sugars 27.7 % — 35.8 %) and the seeds on account of the high percentage of proteins 28.5 % and fat, 16.8 %. Neither contained alkaloids nor cyanogenetic glucosides.

The pods consisted of pod-case 41.2 %; powdery material 33.4 %; seeds 25.4 %. It is stated that on the Gold Coast, the aqueous extract from the pod-cases is used for binding floors. The material is of a pectic nature having adhesive properties; a quantity of tannin is also present.

M. L. Y.

376. Pasture Top-Dressing Experiments at Te Kuiti.

PATTERSON, T. H., *New Zealand Journal of Agriculture*, Vol. XXVI, No. 4, pp. 233-238, tables 2, figs. 5. Wellington, 1923.

The author gives an account of phosphatic fertiliser trials carried out on permanent pasture. The experiments were carried out on pasture laid down 8 years previously and which had received no fertilisers for more than 5 years. The average results of two years' trials is given below:—

Fertiliser used	Amount per acre	Yield of Hay per acre av. of 3 plots				Increase due to Fertiliser				Percentage increase
		tons cwt. qr. lb.				tons cwt. qr. lb.				
<i>Unlimed</i>										
Check.	None	1	3	0	1	—	—	—	—	
Basic slag.	3 cwt.	1	12	2	2	0	9	2	1	41.3
Superphosphate . . .	3 cwt.	2	3	0	6	1	0	0	5	87.1
Rock phosphate . . .	3 cwt.	1	11	1	22	0	8	1	21	36.7
<i>Limed</i>										
Superphosphate . . .	3 cwt.	2	0	0	17	0	17	0	16	74.5
Rock phosphate . . .	3 cwt.	1	7	2	16	0	4	2	15	20.1

The figures show that under the conditions of the experiment, superphosphate gave a much higher yield than slag or rock phosphate. Differences in the nature of the herbage on the plots were noted, Yorkshire fog being abundant on the superphosphate plots; the feeding quality of the pasture as a whole was improved.

The average rainfall during the two years' trials was 56.80 and 53.85 inches respectively.

W. S. G.

377. Forage Plants for Dairy Cattle in New South Wales.

HAYWOOD, A. H. (Manager, Wollongbar Experiment Farm). Dairying under North Coast Conditions. *The Agricultural Gazette of New South Wales*. Vol. XXXIV, Part I, pp. 41-48. Sydney, 1923.

The information given in this article is based upon experiments made at the Agricultural Station at Wollongbar. The author recommends the following forage plants for dairy cattle, cultivated under conditions of drought such as are met with on the northern coast of New South Wales.

Paspalum repens grows luxuriantly in summer, but towards the end of that season, it seeds and quickly loses its nutritive properties. Further, after some years the ground on which this crop has been grown becomes covered with roots that prevent the air having access to the soil and cause the loss of much rain-water.

In order to remedy this difficulty, the author recommends that the crop be ploughed-in, so that it may rapidly decompose, after which a strong-growing plant that will exterminate *P. repens* must be sown. *Sorghum halepense* is very suitable for the purpose. After a second crop has been grown, the ground may be again sown with *P. repens*.

In addition to *S. halepense* which is very well adapted for the first crop, there are other plants that can be used such as Elephant Grass (*Typha elephantina*), Guinea Grass (*Panicum maximum*), "piassava", (*Attalea funifera*) and "Kikuyu Grass" (*Pennisetum clandestinum*) all of which are equally suitable. They make a good change of fodder for stock which eat them with avidity.

The pastures should be divided into enclosures so that green food can be provided for the animals at almost every season of the year. This subdivision of the ground would also encourage the growth of white clover (*Trifolium repens*) which is apparently the only plant able to live in company with *Paspalum*. When several small enclosures are available, the cattle can be turned into one to keep down the *Paspalum*, which may be cut in another by means of a reaper and removed, thus giving the white clover a better chance to grow. *Paspalum repens* can be made into silage, but it has little nutritive value and must be fed with concentrates. It makes an excellent litter. Among the various grasses that can be used the author recommends *Dactylis glomerata* (Cock's foot grass), *Bromus ciliatus*, and *Agropyrum repens* (Couch grass). These grasses supply a large amount of nutritious appetising food during the 2 or 3 years before *Pas-*

palum repens has taken possession of the ground; they also make excellent winter fodder.

Rhodes Grass (*Chloris Gayana*) is another very useful plant, but it must be prevented from growing too rank, otherwise it becomes tough and unpalatable to the cattle. This applies also to Guinea Grass (*Panicum maximum*) which makes excellent fodder and yields sometimes as much as 40 tons per acre. The native blue couch grass (*Agropyrum*) has always been valued as a stock feed and also on account of its resistance to long periods of drought. Para Grass (*Panicum molle*) makes good hay, and stands trampling and frequent grazing. Other grasses also mentioned by the author, in this connection are: "Kikuyu Grass" (*Pennisetum clandestinum*) which must be kept closely grazed, and Elephant Grass (*Typha elephantina*).

For a farm of 100 acres, the author suggests the following fodder plants being sown on an area of 20 acres:

Maize	5 acres
<i>Sorghum halepense</i>	5 "
Cow cane (<i>Saccharum officinarum</i>)	5 "
Wheat	3 "
Sweet potatoes	2 "

Total 20 acres

Fitzroy is the best variety of maize for fodder in New South Wales. One of the advantages of maize is that it can be grown as a mixed crop with pumpkins, Italian rye-grass or *Vigna sinensis*.

Sorghum halepense, if sown in August or September, is ready for cutting in February, but it is chiefly valuable as a winter fodder. If sown in February, it will produce 15 to 20 tons per acre and provide fodder throughout the winter and as late as the end of August. This variety of Sorghum should not be grazed on the field, but cut and fed to the stock, mixed with a concentrate such as ground maize or oats, and bran. Thirty lb. of chopped sorghum mixed with 4-5 lb. of concentrates make a good winter ration.

The cereals, wheat and oats, may be cut as green fodder in winter, or hay in the spring, and chopped and fed with concentrates. If they are likely to be attacked by smut or rust, they must be cut early and used for chopped straw. The varieties of wheat preferred by farmers are: Thew, Warsen and Huguenot.

Algerienne is the favourite kind of oats. The author advises that more wheat and oats be grown, mixed with vetches or field-peas.

The common sugarcane and the Indian variety also make excellent fodder when mixed with a concentrate. The Indian variety of sugarcane should not be grown where the ordinary kind thrives satisfactorily.

F. S.

378. **Behaviour of Hubam Clover in Ohio. (1)**

WILLARD C. J. (Ohio State University). *The Breeders Gazette*, Volume LXXXIII, No. 15, pp. 505-506. Chicago, April 1923.

Results of two years observations, made in Hubam clover compared with sweet white biennial clover are summarised as follows :

Hubam in favourable seasons will give a larger yield of hay, following cereals, than any other clover. The yield was 3930 lb. per acre following early oats, compared with 2570 lb. of the biennial. As regards total growth, the biennial has proved superior : 240 lb. roots, and 2730 lb. tops (Hubam) and 1480 lb. roots and 2090 lb. tops (biennial). As a soil improving crop, Hubam is therefore not recommended except where an annual crop is required. The nitrogen content of both roots and tops also compared unfavourably with the biennial. The weed problem is also a difficulty, but the value of Hubam clover in many situations where more expensive seed is impracticable, should not be overlooked. The value as a honey producer and the fact that it is possible to have a continuous production of bloom from late in May until after frost, by relying on biennial sweet clovers, and on Hubam is worth consideration.

Superior root yields have been reported in Iowa and indicate that under certain conditions, Hubam roots are equal in value to biennials.

M. L. Y.

379. **Sunflower Silage.**

AMOS, A. and WOODMAN, H. E. (School of Agriculture, Cambridge University). *The Journal of Agricultural Research*, Vol. XIII, Part 2, pp. 163-168. London, April, 1923.

An account of trials with the « Giant Ensilage », sunflower variety, grown for storage in the silo. This crop, planted on light gravel soil gave a yield of 20 tons of green matter per acre, containing 18.5 % dry matter, which compared favourably with the maize crop grown simultaneously (14 tons per acre).

After storage in the silo for three months the silage was examined and appeared to be of good quality, after removal of the top layer of waste material. An outstanding feature of the results was the extremely low percentage loss of dry matter which occurred, namely 4.8 %, appreciably lower than any of the corresponding figures obtained in the ensilage trials with oats and tares. The crude protein underwent very little change, but the digestibility value was somewhat lowered. Full data is given with reference to the composition and changes in content of dry matter of green sunflower and sunflower silage.

Trials made in the United States have already demonstrated the value as a stock feed and as a substitute for maize silage. An experiment to test the palatability of this fodder was made at Cambridge. The authors consider, however, that further investigations as to digestibility and value as a cattle feed, and improved methods of cultivation in order to reduce the fibrous nature of the stems, are necessary before sunflower silage can be recommended on a large scale for feeding stock.

M. L. Y.

(1) For experiments in Natal (S. Africa) with Hubam, see R. 1922, No. 415. (Ed.)

380. Experiments in the Close Sowing of Linseed.

OPRTZ, Versuche über die Aussaatstärke von Lein. *Illustrierte landwirtschaftliche Zeitung*, Year 43, No. 12, pp. 93-94. Berlin, 1923.

On account of the high price of linseed, German research workers have endeavoured to determine whether it might not be advantageous to use thinner sowings than those generally customary, with the object of increasing the seed crop yield. The author gives an account of the results of experiments made at the Silesian Chamber of Agriculture and carried out under his direction. In the first trials 152 — 112 — 80 — 53 kg. of seed were used per hectare, yielding respectively 670 — 655 — 619 — 529 kg. of seed per hectare; 3800 — 3390 — 2910 — 2220 kg. of straw and husk; 872 — 656 — 579 — 391 kg. of tow and fibre and 596 — 423 — 362 — 236 kg. of fibre.

In the second trial, 240 — 160 — 120 — 80 — 40 kg. of seed were used per hectare, giving yields of 498 — 504 — 571 — 598 — 574 kg. of seed per hectare, 3950 — 3360 — 3240 — 2975 — 2275 kg. of straw; and 810 — 676 — 574 — 417 kg. of fibre per hectare.

Thus in both the trials the straw yield, as was to be expected, diminished as the seeds were more sparsely sown, while the seed yield showed some diminution in the first case when the seeds were sown in rows and an increase in the second when they were broad-casted.

Speaking generally, it is desirable to use medium close sowings, the price of the seeds and fibre determining whether the sowing should be reduced or otherwise.

F. D.

381. East African Bamboo as a Paper-Making Material.

Bulletin of the Imperial Institute, Vol. XX, No. 4, pp. 458-460. London, 1922.

Extensive forests of bamboo (*Arundinacea alpina*) are found in Kenya Colony, the value of which for paper-making has been definitely ascertained by investigations carried out at the Imperial Institute. Licences are issued by the local Government for working two Forest areas, one of which is situated on the slopes of the Kikuyu Escarpment and the other in the Mau Forest Reserves. These areas are capable of yielding about 60 000 tons of paper-pulp annually. The system of cutting will be based on a ten years' rotation, that is to say, each block which has been cleared will be given ten years rest before it is cut again.

In 1920, trials were carried out in the laboratory of the Imperial Institute and by a Firm of paper manufacturers. The bamboo stems were from 1.5 to 2 inches in diameter, with nodes from 18 to 24 inches apart. Chemical analyses were made for comparison with the Indian bamboo (*Bambusa Tulda*) the results of which were as follows:

	East African bamboo per cent.	Bambusa Tulda per cent.
Moisture	9.5	8.6
Matter soluble in water	3.6	2.5
Cellulose in material as received	47.5	53.4
Cellulose expressed on moisture free material	52.5	58.4
Ash	1.2	4.1

The length of the ultimate fibres was from 1.6 to 2.7 mm., with an average of 2.3 mm., being almost identical with the measurements of *Bambusa Tulda*.

The pulps obtained in the trial had good felting qualities and formed a pale brown paper of good strength. The pulp was readily bleached and yielded a white paper of good quality: the amount of bleaching powder used was about the same as in the case of soda wood-pulps. The yield of pulp was slightly lower than that from the Indian *Bambusa Tulda*.

A firm of paper manufacturer's carried out trials with about 1 ½ tons of the bamboo and obtained a pulp which bleached satisfactorily and yielded a good quality paper. The pulp when converted into a pale-tinted paper yielded 41.23 per cent. (including loading and size) of the weight of the bamboo treated. The bamboo is considered to be a promising material, but improvement would result by keeping stems of different ages separate from one another. This source of pulp for the manufacture of paper is well worth further consideration. W. S. G.

382. Observations concerning Tannin in the Tea Leaf.

CARPENTER, P. H. and HARLER, C. R., Scientific Department, Indian Tea Association, *Quarterly Journal*, Part III, pp. 99-107, tables 4, figs. 3, bibliography. Calcutta, 1922.

North-East Indian teas are generally pungent, with "body" and the price of Assam tea is based largely on the tannin content, with which its qualities are connected more or less closely. Finished Indian teas contain more tannin than those from Ceylon and China, as shown by analysis.

	Tannin % on dry finished black teas	
	Variation	Average
Indian Teas	13.32 to 14.98	14.33
Ceylon "	10.31 " 13.91	12.29
China "	7.27 " 10.94	9.50

The fresh shoot contains from 25 to 30% tannin which, during the subsequent fermentation is reduced to about 15 %. An interesting point is that China bushes grown in Assam have practically the same tannin content as Assam bushes.

In the authors' experiments the tannin was estimated by Lowenthal's method, which consists in determining the oxidisable matter in solution by means of permanganate of potash, both before and after precipitation by gelatine. The difference is a measure of the tannin bodies and a factor is used for conversion of the difference into weight of tannin. For the experiments two half-acre plots were used, one of dark leaved Burma bushes, the other of light leaved, Singlo, Assam native bushes. Two types of pruning were employed, annual and biennial on each plot. The shoots when plucked were divided into bud, first leaf, second leaf and stalk, and each portion was boiled for half an hour in water and the filtered liquid was then analysed for tannin.

*Tannin content of Tea shoots, average percentage on pluckings
from May 26th to November 17th.*

	Bud	No. 1 Leaf	No. 2 Leaf	Stalk
Burma Tea pruned to 14 in. plucked at 27 in.	25.49 %	26.37 %	21.63 %	12.87 %
Burma Tea pruned to 10 in. plucked at 27 in.	24.67	26.28	21.09	11.62

From the above data it is seen that the lighter pruned bushes produce more tannin than the lower pruned bushes, and it is usually accepted that low pruned bushes give poorer quality tea than those which are high pruned. The part of the shoot consisting of the bud and the first leaf is richest in tannin, and the leaf is richer than the bud, hence plucking immature leaf may lower the tannin percentage; also, the influence of the bud and first leaf may be lost if a number of coarser leaves are intermixed, as the tannin percentage decreases with age of leaf, as shown by the following data:—

	Moisture %	Tannin % (on dry leaf)
Bud	76.60	27.94 %
First leaf	78.60	27.94
Second leaf	76.80	21.34
Third leaf	76.90	17.84
Fourth leaf	74.80	14.50

The single leaves are lighter in colour than the Burma leaves and are usually richer in tannin, which agrees with the accepted idea that light leaved bushes give better teas than dark leaved bushes. The seasonal variation in tannin content is considerable; in the case of the first leaves from Burma bushes plucked on May 26, August 4, September 1, and November 3, the tannin percentages were, respectively: 18.02 — 21.00 — 31.93 — 27.74.

In October there is a temporary falling off in tannin which cannot at present be explained. The general increase in tannin as the season advances has been recorded in the case of other tannin plants, especially the oak.

W. S. G.

383. Propagation of Rubber Trees by Budding.

Bulletin of the Imperial Institute, Vol. XX, No. 4, pp. 474-480, fig. 1. London, 1922.

On some plantations, records are kept of the latex yield from a large number of individual trees, and it has been found that most of the rubber is supplied by comparatively few high-yielding trees. It is obvious that economy would be effected by planting only high-yielding trees. The trees on the present plantations have been raised from seed, and very often without investigation as to the quality of the parent seed-trees. It is known that seedlings do not always inherit the good qualities of the parent trees, hence the only reliable method is that of vegetative propagation. The usual method is to make cuttings, but cuttings of *Hevea brasiliensis* do not root easily. Experiments in Java have shown that the

form of grafting known as budding is very successful, and that the resulting trees retain the quality of the parent tree.

Stocks. — Seedlings of *Hevea brasiliensis* are used for stocks and these should be raised from seed of high-yielding trees. The seedling plants should be spaced at least 2 feet apart in the nursery beds and the stocks are suitable for budding when about $\frac{1}{2}$ inch in diameter at 6 inches from the ground.

Buds. — The buds should be cut from the best-yielding trees only and it is advisable to obtain the buds from as small a number of mother-trees as possible, in order to obtain plants of a uniform type. From 700 to 1000 buds can be cut from one well-grown tree. The thickness of the bark of the bud should correspond as nearly as possible with that of the stock. Cleanliness is essential in all the operations.

The Budding operation: The operations of budding should be done in a definite order, somewhat as follows:—

- 1) Clean the stock so as to remove any soil or grit.
- 2) Cut the bud from the selected piece of branch.
- 3) Make two vertical cuts in the stock and one horizontal cut and lift, and turn back the bark.
- 4) The stock is now ready to receive the bud. Cut the bark of the bud so that it is slightly smaller than the opening in the stock, then insert the bud so that the upper edge of its shield is in contact with the horizontal cut edge of the bark of stock. Replace the tongue of bark of the stock, after shortening, so that the bud is not covered.

- 5) Tie the whole together with a strip of waxed cloth put on like a surgical bandage.

The best time of year for budding is at the beginning of the rains, as during dry weather the bark is difficult to manipulate.

After treatment. — In about three weeks after budding the bandage should be removed and the loose tongue of bark cut off. After an interval of about ten days the bud should be examined and if on scratching the bark close to the bud it is found to be green and healthy, it may be assumed that union has taken place and the stock should then

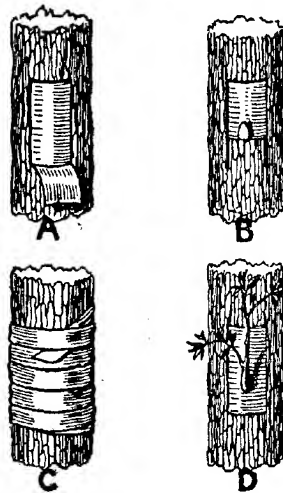


FIG. 83. — Budding of rubber trees.

- 1) Stocks having tongue of bark cut and turned back for insertion of bud.
- 2) Bud in position.
- 3) Bandage applied.
- 4) Bandage removed and graft growing.

be cut down to about 1 foot above the bud. If no union has taken place another bud may be inserted on the other side of the stock. Cutting back the stock may cause shoots to develop at the base of the stock, and these should be removed. In about six months the new shoot will have grown to a height of 3 or 4 feet, when the portion of stock left above the bud should be cut off and the wound covered with melted paraffin wax.

It has been found at the West Java Experiment Station that budded trees up to the age of four years develop a much larger number of latex vessels than seedling trees of the same age, also that they retain the characteristics of the parent trees. As it takes some years to prove the character of seedling trees much money would be saved by budding from high-yielding parent trees since these can be relied on to become high-yielders on reaching maturity.

In an article published by VICTOR RIS (*Arch. v. de Rubb. Ned.-Indie*, p. 195, June, 1922) he deals with the influence of planting material and selection of soil on latex yields. It is considered that an estate now yielding 400 lb. of rubber per annum might have the yield increased to as much as 2000 lb. per acre by grafting selected high yielders on to suitable stocks. The quality of the soil also is so important that by suitable soil selection the yield of the rubber trees can be increased by 50 per cent. thus making it possible to obtain 3000 lb. of rubber per acre per annum on an ideal estate. Taking into account the need for "resting", and other factors, it is estimated that 1200 lb. of rubber per acre ought to be reached on good estates.

W. S. G.

384. **An Experiment made to ascertain the Movement of Latex in the Latex Vessels of *Hevea Brasiliensis* during Tapping.**

VISCHER, W. Over een proef on de latex beweging in de latex vaten van *Hevea Brasiliensis* by het tappen experimenteel aan toonen. *Archief voor de Rubbercultuur in Nederlandsch-Indië*, Year VI, No. 11, pp. 444-447, fig. 2, bibliography 5 publ. Buitenzorg, 1922.

The author wished to trace the source of the latex which flows down to the tapping-groove, also, how far away from the incision the latex is removed from the vessels and at what rate the flow takes place. According to ARISZ, the original latex derived from different parts of the tree show different melting points and by means of this principle he has tried to ascertain the place of origin of the flowing latex.

VISCHER found a diminution of pressure in the vessels up to a distance of one metre from the incision, which could not be explained other than by movement of the latex. BOBLIOFF has carried out experiments on trees with yellow latex (*Archief v. d. Rubbercultuur*, V, p. 95, VI, p. 62 and 112).

The latex of some trees becomes yellow after it has been in the vessels for some time, although newly formed latex is white. The author adopted the same method as BOBLIOFF. Trees were chosen in which the boundary-line of the white latex and the yellow latex occurred at the place of grafting.

Experiment *A* made on a tree grafted at a height of 35 cm. Colour of latex above the point of grafting before the incision was made : yellow.

Trunk: A, 5 cm. below the union, white, after repeated incisions;
 , B, 12 cm. , , , after 5 minutes B, slightly yellow;
 , C, 20 cm. , , , 10 minutes C yellow;
 Incision, 30 cm. , , , 15 minutes incision yellow.

The yellow latex has thus taken 15 minutes to travel a distance of 30 cm. Also, immediately after making the incision, the latex at a distance of 30 cm. began to flow towards the incision.

Experiment *B* on a tree grafted at a height of 45 cm. Colour of latex above the place of grafting : yellow, before making the incision.

Below the place of grafting :

A, 5 cm. below the union, light yellow;
 B, 10 cm. , , , white;
 Incision 40 cm. below the union white.

After repeated incisions :

A, after 2 minutes : begins distinctly to turn yellow;
 , 5 , as yellow as the main trunk;
 B, 20 , , , , ,
 Incision 30 , yellow.

This experiment shows also that, where the incision is open the latex begins to travel towards the incision and starts from a distance of 40 cm., and that latex found at a distance of 40 cm. reaches the incision in 30 minutes.

In these experiments, the tapping was begun from below and continued in an upward direction, contrary to the usual method, because it is easier to note the moment of arrival of yellow latex, than the gradual bleaching of the yellow latex.

It is obvious that it is immaterial in which way the movement of the latex is proved.

The results of these experiments are of practical importance because they show that when tapping takes place at a short distance from the soil, the latex vessels of the lower part of the trunk have an influence on production.

It is evident that the effect of a place in the internal bark which is affected by browning will be shown all the same, although the tapping may have been made at a relatively great distance.

D. V. S.

385. Tobacco Cultivation in Jugo-Slavia.

STAC, UROSCHE. Coltivazione dei tabacchi nella Jugoslavia. *Bollettino Tecnico del R. istituto Sperimentale per la Coltivazione dei Tabacchi Scafati*, Year XIX, Nos. 3-4, pp. 231-233. Scafati (Salerno), 1922.

Tobacco was introduced into Jugoslavia at the time of the Turkish rule and, as it was evidently suited to prevailing conditions, the cultivation area was extended without delay and is now an important crop, and maintains its popularity.

The chief centres of cultivation correspond with the more important vine areas, namely in *Servia* at Bajina Besta; Moravia (neighbourhood of Zitkovatz and Alexinats), Rassina (neighbourhood of Kruscevat); Vragno, Kumanovo, Skoplo; Bregalnitz; Prilip; in *Herzegovina*, neighbourhood of Trebigno, Stolat, and Ljubuski; in *Bosnia*, the entire country, especially near Vrgoratz. In Voivodina (Banato and Backa) and in Slavonia, tobacco is also grown to a considerable extent. In Slavonia preliminary trials were made in 1920, but since then results have not proved very encouraging, probably due to unsuitable climatic conditions.

The best quality tobacco comes from Skoplie, Bregalnitz and Herzegovina.

Two grades of tobacco are grown: small leaf and large leaf. The first is used only for cigarettes, is of Turkish origin and resembles the Turkish tobacco; sweet taste, fine, light colour, very scented; 3 % maximum of nicotine. This type is grown in the district south of the Sava and Danube rivers not including Bosnia and Herzegovina. In Dalmatia equal quantities of both small and large leaf tobacco are cultivated.

The small leaf type is classified as follows:

1) Long-stalked: "Golodranken" with distinctly petiolate leaves; "Porsucian" without petiole.

2) Nearly sessile: "Guscian" and "Guscianato".

The latter type is the most common and several different varieties are grown. The "Guscian" is the most suitable for the climate and gives a more satisfactory yield. It is preferred to "Porsucian" which decreases in popularity.

The cultivation of long-stalked tobacco is confined chiefly to the Voivodina district and to Slavonia. The leaves measure about 50 cm. length and 35 cm. across, strong flavour, useful as pipe tobacco but can also be mixed for cigarette purposes.

The war has seriously affected the tobacco industry in Yugoslavia and reestablishment of normal conditions is slow owing to the economic necessity of reserving wide areas solely for cereals.

F. D.

386. Comparison between the chief Types of Tobacco in Deli (Dutch East Indies).

JOCHEMS, S. C. J. Onderlinge vergelyking van de voornaamste typen van Deli-tabak. *Mededeelingen van het Deli Proefstation te Medan Sumatra*, Series 2, No. XXV, pp. 1-37, plates 6. Medan, 1923.

During the last 8 years, there has been no alteration in the system of tobacco selection employed in Sumatra (Dutch East Indies). Recently, however, a new method for measuring the length and breadth of the leaves has been introduced. Hitherto, measurements and enumerations were made of the leaves on the plant, and as marked variations are liable to occur, it was necessary to record at least 100 plants for each type. To ensure a reliable basis on which to work, this method involves the measurement of an enormous number of leaves in a limited time — a difficult proceeding under tropical conditions. The new method consists of a simpli-

fied system of collection and measurement of leaves on a board subdivided into half-centimetres.

It is estimated that a quick-worker can measure 1500 leaves in one morning. The inconvenience of this method is that the leaves when collected, have not yet reached their maximum development. The types differ in this respect; the author has therefore made investigations as to the results of a cross between a slow growing type with a quick-growing type. Measurements were made of the leaves beginning from 8 days previous to harvest and continuing for 6 weeks. It was observed that a leaf from a slow grower is limited to an increase of $\frac{1}{2}$ cm. length and breadth after ripening and from a quick-grower, the size remains stationary. The shape of the leaves is regulated by the rate of increase in size. The length and breadth enlarges from base upwards; from the tenth leaf, the increase is less obvious except that the length is elongated in proportion to the breadth.

Taking into account the possible errors liable to occur when measurements are made just before maturity, the new method is preferable owing to the large number of measurements of which it allows.

A detailed description is given concerning the appearance of the 7 different lines, the chief sources of seed in Deli, the number of leaves, the date of flowering, and the position of the leaves on the stem which comprise the chief points of difference. The author states that the 7 lines described are undoubtedly 7 distinct types.

As regards shape of the leaves three sets of observations were made: 1) the 3rd and 4th leaf; 2) the 5th and 6th; 3) the 9th and 10th; in each case for each line, 1500 leaves were examined and measurements taken. The results are tabulated and the number of leaves per plant of the different lines is given, which varies from 22 to 43, and also the height of the plants (to the uppermost blossom). The tallest plants are invariably associated with the greatest number of leaves.

In order to determine the influence of the density of leaves on the fineness of structure and on the quality of the tobacco, further counts were made of the leaves at a height of 3.2 ft., collected immediately before the harvest of the first leaf and directly after the harvest of the eighth leaf. The differences due to growth of the stem are negligible and as a rule the number is invariable.

Measurements of stem thickness at different heights above soil level are noted. The author doubts if there is any correlation between this thickness and the leaf yield. The number of leaves may be considered rather as related to the date of flowering. Late flowering results in a greater quantity of leaves.

The characteristics of practical value are the superior yield, colour and quality of the fermented produce and the combustibility.

The line which possesses the greatest number of qualities should be cultivated on a large scale. A comparison should therefore be made of the qualities of the fermented product and the plants in the fields. The author states that one line especially has shown a superiority to many other types. The quality of the tobacco is superior, the colour is attractive,

the leaf surface is good, the average number of leaves per plant and more especially the total yield per field is distinctly higher. The number of leaves varies from 33 to 43, average 36.7 *i. e.* 4 leaves more than the line following and they are 1 cm. more in length. An economic advantage in practice is the slow rate of ripening of this type, in consequence of which the harvest is not hurried.

Three other types, each with special characteristics have been proved to be suitable for cultivation, but these are more exacting as regards soil. Experiments relative to this fact will be made during the coming years.

D. V. S.

387. Cultivation and Production of Cinchona (Quinine).

I. PIERAERTS, J. Le Quinquina. Congo, *Revue générale de la Colonie belge*. Year III, Vol. II, No. 5, pp. 667-806.

II. *Indian Trade Enquiry, Drugs and Tanning Materials*, Imperial Institute Report of Cinchona Bark, pp. 1-40, tables XII + Statistics. London, 1922.

III. SANDS, W. A. (Assistant Economic Botanist Dept. of Agriculture, Federated Malay States), The Cinchona (Quinine) Industry in Java. *The Malayan Agricultural Journal*, Vol. X, No. 3, pp. 65-86. Kuala Lumpur, F. M. S., 1922.

I. — A detailed survey of all aspects of cinchona bark cultivation, origin, species, medicinal value, followed by an account of the results obtained with specimens of *Cinchona succirubra* Pav. at the "Direction de l'Agriculture au Jardin botanique d'Eala" (Belgian Congo).

The chief source of quinine, namely the Dutch Indies cannot cope with the ever increasing demand, and attempts to extend the cultivation are being made in other countries, such as China, Brazil, Madagascar, Jamaica, etc. to supply local needs.

Analyses of Bark from Cinchona succirubra at Eala.

	Moisture		Dry Matter		Total Ash		Total Alkaloids		Alkaloids soluble in ether		Quinine sulphate	
	Single stock	Several stocks	Single stock	Several stocks	Single stock	Several stocks	Single stock	Several stocks	Single stock	Several stocks	Single stock	Several stocks
Bark from branches	10.55	10.15	89.45	89.85	7.38	3.46	6.95	6.53	6.70	5.58	2.32	2.45
Residue from branches	10.27	10.52	89.73	89.48	3.65	7.26	7.11	5.39	7.23	5.15	1.64	0.83
Residue from twigs	11.30	10.52	88.70	89.48	7.70	7.26	5.45	5.39	4.03	5.15	1.59	1.67
Bark from roots	9.30	10.15	90.70	89.85	3.61	4.09	7.26	6.45	6.36	5.65	2.35	1.67

The bark obtained at Eala is evidently of superior quality and indicates the adaptability of *Cinchona succirubra* to the climatic conditions of the Belgian Congo and the importance of making further cultural trials with a view to the stabilisation of this species, which after a few

years should supply 800-900 kg. of quinine sulphate per annum and meet the local demand.

II. — Report of the Indian Trade Enquiry dealing with cinchona bark cultivation, production, trade and utilisation throughout the world. Attention is drawn to the fact that at present Java produces about 23 000 000 lb. of bark, that is, 90 % of the total world's production, and the possibilities of increasing the production in India and Africa (including full statistics as to exports etc.). Cinchona bark produced in St. Helena, East Africa and in the Cameroons has recently been received at the Imperial Institute, London, and chemical analyses made of *Cinchona robusta*, *C. succirubra*, *C. Ledgeriana* and *C. Ledgeriana* × *C. succirubra* together with an account of the methods of cultivation in these countries.

III. — W. A. SANDS gives a detailed description of the gradual increase in cinchona bark production in Java, the acreage planted, the species, etc. cultivated, and the methods employed. The remarkable success obtained is due chiefly to the careful selection and propagation, largely, of *Cinchona Ledgeriana*, the regulation of market prices, the plentiful supply of cheap labour, the ideal conditions of soil etc., and the valuable experimental work of the Government Cinchona plantations.

The author gives the exports of quinine sulphate and bark from the Dutch East Indies for the years 1916-20. The average annual production is estimated as follows:

1st Year:	125 lb. dry bark.	5 % quinine
2nd »	250 » » »	6 1/4 % »
3rd »	375 » » »	7 % »
4th »	500 » » »	7 1/2 % »
5th »	630 » » »	8 % »

An examination of the alkaloid content of *C. Calisaya* and *C. Ledgeriana* shows the outstanding superiority of the latter as a source of quinine. The annual increment of quinine in the bark is studied closely in the selection and observation gardens, and samples of stem bark are taken each year from each type grown and analysed. It is a noteworthy feature that the quantity of quinine contained in the bark is not the same, even when the grafted trees are all derived from one parent tree and grown near to each other under similar conditions.

A description is given of the method of marketing and extraction of quinine.

M. I. Y.

Vine growing.

388. Influence of Vine Training on Fruit Production.

UCHTER, E. C. and BALLARD, W. R. *Bulletin No. 250 University of Maryland Agricultural Experiment Station*, pp. 207-234, figs. 22, bibliography. College Park, M. D., 1922.

Records of yields obtained from different varieties of vines trained according to five systems at the University of Maryland Agricultural Experiment Station viz. — Single Stem Four Cane kniffen, Single Stem

Two Cane kniffen, Two Wire Umbrella or Umbrella kniffen, Munson 3 wire cross-bar system, and the Fan.

Under Maryland conditions, the Single Stem Two Cane kniffen appears to be the most satisfactory method. Posts are set 24 ft. apart, 3 vines between each two posts and no vine nearer than 4 ft. from any post. The lower wire is placed 2 ½ to 3 ft. from the ground and the upper wire from 2 to 3 ft. above the lower one. First year, the cane is pruned back to two or three buds, and the shoots staked or allowed to trail. Second year, all canes but one are removed and this is cut back to two or three buds. Third year, all canes but one removed and this should be carried to top wire and secured; all shoots should be retained, the excess canes can be removed at the next pruning, giving the vine the advantage of their growth during the summer. Vines pruned thus, often have the most vigorous shoots near the head. Fourth year: two vigorous canes selected just below the lower wire and trained to right and left along the wire, shortening back to 4 buds; a similar system is followed along the upper wire shortening back to about 6 buds. Two more canes are cut back to spurs close to the main stem at each wire, and only one or two buds left. From such renewal spurs, canes for training along the wires will be developed for the following year. All other canes should be removed. Fifth year, training similar to fourth year system. In selecting the canes it is advisable to choose the round, medium sized ones, with average internodes and round buds. It will probably be profitable to select spurs on wood older than two years as shoots on such wood seldom bear fruit and will make good fruiting canes the next year. Canes on the upper wire should be cut back to about 10-12 buds, and the forthcoming fruit bearing shoots allowed to droop down without tying. The number of buds to leave each year will depend on several factors but good vigorous, mature vines growing on average soil should show 30 to 40 buds, i. e. 60 to 80 clusters of grapes.

The yields obtained per acre are distinctly higher with this system than with the others giving high grade fruit. The Munson system also gave good yields but the additional expense and time required for erecting the trellis, and the greater difficulties of picking and spraying make this method inferior. The three other less profitable systems of training are also described in detail, also several other less common methods applicable to weak growing varieties, when it is an advantage to train the shoots upright.

M. L. Y.

389. Hybridisation of the Vine.

I. — ZWEIFELT (Leiter der staatlichen Rebenzüchtungsstation in Klosterneuburg). Rebenkreuzungen. *Allgemeine Weinzeitung*, Year 39, No. 44, p. 167; No. 45, pp. 171-172. Vienna, 1922.

II. — IDEM. Die Technik der Rebenkreuzung und die heurigen Ergebnisse im Lichte derselben. *Ibid.*, No. 50, pp. 193-194; No. 51, pp. 197-199 No. 52, pp. 203-204.

I-II. — A description is given by the author, Director of the "Rebenzüchtungsstation" (Vine Breeding Station), at Klosterneuburg (Lower

Austria), of the crosses made in 1922, including 100 known varieties, and of 45 self-pollinated varieties. Amongst the cross-pollinated varieties may be mentioned: White Burgunder Neuburger; Orange Traube; Grey Portugieser; Red Veltliner; Blue Portugieser; White Riesling; White Gutedel; White Welschriesling (Oesterreichisch); Rotgipfler (Blaufrankisch); St. Laurent; Red Ziefandler; Red Sylvaner; Green Sylvaner; Blue Wildbacher; Red Traminer. These crosses should give superior quality fruit.

As a substitute for cross-pollination of various vines with pollen from the stock Berlandieri Riparia Kober B and Berlandieri Riparia Kober 5 BB, it is considered probable that better results will be forthcoming with the stock used in Lower Austria, the most popular stock being the Green "Veltliner", suitable for calcareous and most other types of soil.

F. D.

390. A New Method of Grafting Vines.

BRICHET, P., Une nouvelle greffe pour la vigne. *Le Progrès agricole et viticole*, Year 44, No. 2, pp. 31-33. Montpellier, 1923.

The author has introduced a new method of budding as a substitute for the "Mayorquine" system. The graft consists of a shield shaped bud which is inserted in the upper portion of the stock in an oblique cut.

This method can be employed *in situ* and with a small scion, but it will in such a case be advisable to cover the tip with paraffined paper to avoid drying.

The following advantages are noted: The shoot is an extension of the stock and will develop into a rectangular form. The union is complete and the graft grows more quickly as a consequence of the direct union of the cambial surfaces. The dead wood is reduced to a minimum and the callus formation is rapid. This method causes a distinct saving of labour.

R. D.

Forestry.

391. Crop Rotation as applied to Forests.

ROUILLEAU DE LA ROUSSE. *Bulletin du Comité des Forêts*, Year X, No. 1, pp. 318-326. Paris, 1923.

In the author's opinion foresters in the past were not opposed to the idea of changing from time to time, the species growing in the forests. They were, however, more inclined to introduce types growing on the same soil, which is in itself a form of rotation, on account of the difficulties and cost of a more complete system. The Department also seems to have considered the economic more than the cultural side and has at times gives orders which were harmful and not in accordance with the theory of crop distribution. Thus in 1855, when oak wood was very expensive, orders were given to eradicate beeches from the oak forests.

The author advises an alternation of species, but it should not be carried out roughly or on hard and fast lines. If a forest has not been too much

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damaged by bad clearances or bad general management, the greatest efforts must be made to maintain on the soil the kinds which have always thrived there.

It is only in exceptional circumstances that the immediate or progressive substitution of groups of trees can be considered. For example: the order given to destroy most of the beeches in the forest of Sercé, situated on acid siliceous soil, speedily ruined several of its oak plantations. After the disappearance of the beeches the heather began to spread and invade the undergrowth, but when this was removed, the author saw innumerable vigorous clusters of oak-seedlings springing up. From 1885 to 1910 a regular campaign was carried on against the encroaching heather. It was all up-rooted and beeches planted between the large clusters of oak-seedlings. His efforts were useless and henceforward a rotation with silvan firs has become a necessity.

In forest coppices rotation of species takes place naturally in many places, but in many others, artificial rotation has often to be drastically applied.

For example the case may be taken of a forest where the oak-tree was supreme in former days, intermingled with a few birches and aspens. The "white" disease attacks the oak-tree almost every year from 1909 onward; birches and aspens are spared, and within a short period they spread all over the wood. The hornbeam is a species which, in the vicinity of oak-trees suffering from "white" disease, has the same effect as the birch and aspen.

The hornbeam seeds very profusely every year, it is therefore difficult to maintain beeches and oaks where this species has established itself. But the hornbeam coppices are finally destroyed and supplanted by aspens and under the aspens, the oak-tree naturally returns. This, therefore is a case of natural rotation of species.

But if the soil has lost its fertility, birches and heather will take the place of the oak-tree and an artificial rotation with pines will be required.

Natural rotation works slowly and to hasten its progress, the simple coppice or the old and completely spoilt, oak, beech etc. coppices, can be replaced by fir-trees from the Jura, forest-pine, larches or green Douglas. At Laigle (Orne) and elsewhere, coppices were transformed into fir forests in less than a century, since the forest-pine grows in 30 years. A less radical method can also be adopted. In a completely ruined deciduous forest of birches from 20 to 25 years old and thinly distributed, the author had planted groups of resinous trees (2 plants of Normandy fir at 2 points per hectare) a form of plantation that entails practically no expense and is convinced that in about 80 years, without any further cultivation, the firs will have fertilized the coppices in large patches, and that for 150 years, the forest will be marketable. The following example corroborates this view: 130 years ago, the forest coppices of the estate of Arlay in the Jura, did not contain a single fir-tree and were worthless. At a certain time, the fir-trees of the commune of the "Haute Joux" spread their seeds abroad and the fir seedlings were allowed to develop. To-day the last traces of the coppice have disappeared. The author advises that the beech

shoot of the saddle kind which are found there and are very vigorous should not be disturbed. Thus will be obtained a rotation of species, with fir trees and beeches in combination.
R. D.

392. Forest Management in France.

SCHAEFFER, A. (Conservateur des Eaux et Forêts). Development of (French) Management Methods from 1912 to 1922. *Journal of Forestry*, Vol. XX, No. 8, pp. 883-887. Washington, 1922.

The period under consideration was almost entirely occupied by the War which, owing to the enormous demand for wood it occasioned, increased the necessity for transforming coppices into forests. On the other hand, the War proved that forests, whether of conifers or deciduous trees, were able to provide rapidly, trunks of large dimensions without affecting their future utility. The coppices beneath standards, on the other hand, only supplied materials for making small objects or charcoal. Their large reserve trees could not be removed without causing damage, while the necessity of cutting down the coppice in order to reach these reserves has always been a difficulty. Further, the great disproportion between the areas occupied by coppice under tall trees and the cubic measure of large timber obtained from it has led to the condemnation of this method of forestry in France.

The conversion of coppice into high forest, however, necessitates an expenditure of time and money that cannot be met by private individuals. For this reason, a system intermediate between the coppice and high forest was devised, which goes by the name of the "selected deciduous high forest" ("futaie jardinée feuillue").

The tendency of the new methods is towards more frequent felling, the leaving of large reserves (in order to increase the production of heavy timber) and the gradual substitution of regeneration by shoots for reproduction by seed.

In a forest divided into 30 felling lots, 2 fellings are made annually, so that every 15 years, each lot is subjected to a felling which is at the same time a selection thinning. Trees of an age to be used as timber, as well as defective specimens, are cut down, the groups are thinned and the development of valuable species attended to. The felling, however, is limited in such a manner that before the next cutting, the forest has regained its original density.

Let V be the volume before the felling, x the fraction exploited, t the amount of growth and n the number of years of the period under consideration. We then obtain the following formula (based on the formula of compound interest): $(V - Vx)(1 + t)^n = V$; whence we have:

$$x = 1 - \frac{1}{(1 \pm t)^n}.$$

If we consider the average trees with an increase in size of about 3 %,

and take a period of 15 years, we get: $x = 1 - \frac{1}{1.03^{15}} = 0.36$.

In this case, if 36 % of the reserve is used, this is renewed at the end of the 15 year period.

If the object is to enrich the forest, the staddles need not be counted in the estimation of the initial volume, or else an increase of, for instance,

$\frac{1}{5}$ of this volume may be aimed at in 15 years. The formula then is

$$(V - V_x (I + i)^n = V + \frac{V}{5}$$

With $i = 3$ and $n = 15$, it is seen that the felling should be limited to 27 % of the reserve volume. This estimate is important, for it gives the owner information respecting the future of the forest he is exploiting and prevents impoverishment. The advantages of this system, which has already been adopted in the case of numerous communal forests are, further, as follows:

Frequent cutting at the same place insures the vigorous growth of the young shoots; even immediately after felling, the spaces between the large trees are of small extent, so that the soil is always occupied. Finally, the trees grow more nearly to the same height which increases the yield of large timber and decreases the amount of lopping required.

When the coppices under high forests are situated at an altitude of over 400 m., conifers are usually planted, these trees produce 10 cubic metres of saw-timber per annum and per hectare, whereas deciduous trees never yield more than 4 metres. The yield of the Douglas fir at this height would probably be even more, although in low-lying districts like Sologne, this tree has not been able to resist the draught of the last few years.

R. D.

393. Logging in North-West America (British Columbia and Pacific States).

KAY, J. *Transaction of the Royal Scottish Arboricultural Society*, vol. XXXVI Pt. II, pp. 152-157, figs. 10. Edinburgh, 1922.

The development of forest areas inaccessible by ordinary means of timber transport has necessitated the adoption of new methods of handling and transport. Hence the construction of flumes, chutes, etc. Flumes can be constructed more cheaply than a railroad and can be worked without fuel or skilled labour. The first stage in flume construction consists in an accurate survey of the proposed line of flume, the best grades, curves, and probable cost. The grades may vary from 1 % to 25 % or more; 2-6 % grades are, however, the most efficient. The available water-supply will determine the type of flumes and whether square or V-shaped. The latter type is considered the best. The water is confined and has the greatest carrying power owing to the shape and tends to lift the log, and is less likely to cause a jam; also, this system requires less water than the other types. The 90° angle seems the best for all purposes. The usual procedure is to erect a saw-mill near the upper end of the

PLATE XXV.

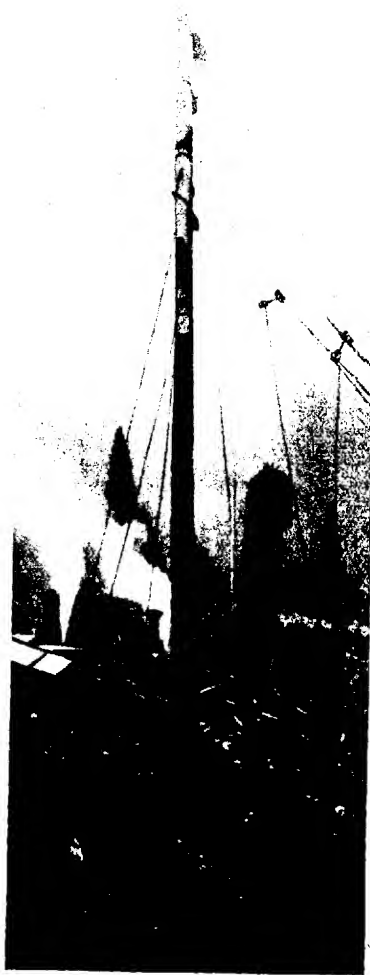


FIG. 84. — The spar tree rigged ready for yarding and loading by means of two donkey engines.

flume, and to saw out the material required; as the work proceeds the lumber is floated down as required. In the autumn when the water becomes scarce, use is made of an iron apron which acts as a dam and keeps back sufficient water to give force enough when released to set the logs going. A telephone line is usually carried along the flume; when a jam occurs word is quickly passed down to the skidding crews and loading is stopped and the water turned off until the obstruction is removed.

In the early years of the lumber industry on the Pacific Coast beasts of burden were largely used for skidding purposes. Owing, however, to the size of the timber, and the topography, other means of transport were found to be necessary. Near the coast, logging railroads have been constructed. The locomotives used are mostly geared, which enables them to climb heavy grades up to 7 % or more. The fuel used may be oil, coal or wood, depending on circumstances. The wagons are very strongly built and are supplied with automatic couplings, air and hand-brakes. Felling and cross-cutting are still done by axe and saw, but the old trees are often swell-butted and spring-boards are used to reach the point above the swelling which prevents slipping on sloping or soft ground.

In British Columbia the high-lead system is more common. The logs are hauled to the side of the railroad where they are loaded on the wagons; when the train is filled it is replaced by a new line of empty wagons. Spar trees are left at distances of 1000-1200 ft apart and about 12-15 ft. from the railroad. The rigger climbs the tree and at a height of 120-200 ft., lops off the top with axe and saw (lately, this has been done in some cases by stringing together several sticks of dynamite and placing around the tree top, and firing the charge by means of a detonating cap attached to a long fuse). To give rigidity to the spar tree, 6 cables are placed near the top and 3 near the middle; a high-lead block weighing 500-900 lb. is then hung 5-15 ft. below the cables, and is fixed to the spar-tree by means of a 1 1/2 inch plough-steel strap. The loading tackle is also installed before the rigger descends from the tree (See Plate XXV, Fig. 84). Two donkey engines are used, one for yarding (skidding), the other for loading. These are operated from one massive platform and are expected to haul and load logs often 10 ft. in diameter and 32 ft. or more in length. They are equipped with high-pressure vertical boilers and have a working pressure of from 150-200 lb. per sq. inch. A detailed description is given of the methods of transportation. Two main drums are placed tandem fashion on the platform; these carry the main hauling line and the trip line (haul back). The latter is a small wire rope travelling between the power-skidder and a pulley to be dragged and used to return the main cable with chokers, etc. for the next log. The main yarding line varies from 1-1 1/2 inch in diameter and from 900-1500 ft. in length and is made entirely of steel. A third drum carries the straw line and is used to run out the trip-line, or as a haul-back, either when a new setting is being made or when roads are being changed. The "Wentworth" patent core-rope is said to be the best wire rope used in British Columbia; this prevents the strands from crushing each other, and consequently does away with in-

ternal friction that wears away the individual wires of the strands. Trip lines are $\frac{5}{8}$ - $\frac{3}{4}$ inch in diameter and about $2\frac{1}{2}$ times as long as the main yarding lines. An electric signal is used for transmitting orders.

R. D.

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394. MUNDY, H. G. (Chief Agriculturist and Botanist). Distance Planting Trials for Maize. *Bulletin* No. 440, *Department of Agriculture, Rhodesia*, p. 11, Salisbury, 1922.

The trials show that the best yields of grain have resulted from the spacing of 40 ins. between the rows and 15 ins. between plants in the row. When the crop is required for fodder, closer planting is advantageous.

W. S. G.

395. PERCIVAL, Prof. J. Seed Mixtures for Permanent Grassland. *Journal of the Ministry of Agriculture*, Vol. XXX, No. 3, pp. 204-209. London, 1923.

Comparison between the chief methods commonly employed for the production of permanent grass on arable soils: 1) tumble down pastures (random herbage); 2) sowing of hay seeds (from barns and haystacks etc.); 3) use of seed mixtures of commercial grass and clover seeds. The advantages of a complex mixture are discussed and a list of useful mixtures on light, medium and heavy soils is given including details as to preparation of the land and sowing.

M. L. Y.

396. RIVIERE, G. (Directeur de la Station agronomique de Seine-et-Loire). PICHARD, G. Influence de la Couleur des murs d'espaliers sur la hâtivité de maturité des Fruits des pêchers qui y sont adossés. (Effect of Colour of Wall upon Ripening of Fruit of Espalier Peach Trees). *Journal de la Société d'Horticulture de France*. Series 4, Vol. XXIV, pp. 79-82, Paris, 1923.

The fruit of peach-trees trained as espaliers against a black wall ripen much earlier than that of similar trees trained against a white wall; this is explained by the difference in the average temperatures which have been found to be 24.08° C. and 18.81° C. respectively from March 6 to September 8.

R. D.

397. SICARD, H. Moyens pour remédier aux dégâts causés aux vignes par l'orage. (Means of Remedying the Injury done to the Vines by the Hail-Storm). *Le Progrès agricole et viticole*, Year 40, No. 6, pp. 129-137, Montpellier, 1923.

The author examines the question whether it is advisable in some cases to re-prune vines injured by hail, and treats of the best method of gathering the grapes from vines that have been repruned and those that have only been pruned once.

R. D.

398. REYES, LUIS, J. (Forester and Wood Technologist, Bureau of Forestry, Manila). Woods of the Philippine Dipterocarps. *The Philippine Journal of Science*, Vol. 22, No. 23, plates 31, pp. 291-344. Manila, 1923.

Anatomical and technological studies on the woods of various species of *Dipterocarps* in the Philippines. R. D.

399. DUVFJES, J. J. Een kyk in vogelvlucht op het boschbeheer op Java 1911-1920. *Tectona*, tome XVI, No. 1, pp. 1-6. Buitenzorg, January 1923.

A summary of the management of the forests in Java in the years 1911-1920. An examination of the output of teak-timber and the financial results (net-income) of the forest management in the whole of Java as well as in specified areas of that island. D. V. S.

400. LUGT, C. Producten boekhouding voor het boschbeheer op Java. *Tectona*, Vol. XV, No. 12, pp. 1021-1048. Buitenzorg, 1922.

An article on accounting in forest administration in Java.

D. V. S.

401. BECKING, W. and J. H. Ennontwerp voor de hontboekhouding in de Djati bosschen op Java *Tectona*, vol. XV, No. 12, pp. 1049-1069. Buitenzorg, 1922.

Accountancy system for the teak forests of Java.

D. V. S.

LIVE STOCK AND BREEDING.

SYNTHETIC ARTICLES.

402. The Value and Use of Certain Stock Feeds.

I. — KLING H. (Landwirtschaftliche Kreis-versuchstation Speyer). Einige häufig vorkommende Weinbergunkräuter, ihre chemische Zusammensetzung sowie ihr Wert als Futter- und Düngemittel. *Wein und Rebe*, Year 4, Part 7, pp. 311-326. Mainz, 1922.

II. — Fish Meal as a Food for Live Stock (Ministry of Agriculture and Fisheries, Leaflet, No. 333 (Revised, November 1922). London.

III. — PFEIFFER TH. Die Stickstoffhaltigen Verbindungen nichtei-

weissartiger Natur in Futter. *Fühlings Landwirtschaftliche Zeitung*, Year 71, Parts 17-18, pp. 313-324. Stuttgart, 1921

IV. — RICHARDSEN AND BRINKMANN. Milchviehfütterungsversuche mit Harnstoff. *Ibidem*, pp. 325-334.

V. — ENGELS. Die verschiedenen Methoden der Grünfütterung *verwertung resp.* — Konservierung unter besonderer Berücksichtigung der Rübenblätter and sonstigen Blattarten. *Süddeutsche Landwirtschaftliche Tierzucht*, Year 17, No. 25, pp. 299-303. Hanover, 1922.

VI. — FRAPS, G. S. Digestibility of the Sugars, Starches, Pentosans, and Protein of Some Feeding Stuffs. *Ibidem*, No. 290, 21 pp. 1922.

VII. — FRAPS, G. S. Digestion Experiments. *Ibidem*, No. 291, 15 pp. 1922.

VIII. — WHEELER, G. B. The Marketing of Mill Feeds. *Ibidem*, No. 1124, 1922.

I. — *The composition, and the stock-feeding and manurial value of some common vineyard weeds.* — In the vinegrowing regions of the Palatinate, and especially in the highest parts of the Haardtgebirge, vineyard weeds are used as a stock feed, being fed alone or with pruning débris. The author analysed some of these plants and obtained the results given in the appended tables. He took as terms of comparison the composition of meadow hay shortly before flowering, and that of Red Clover in full flower. These two feeds contain respectively: dry matter 25 — 21 — 24; the dry matter being composed of: crude protein 12.0 — 16.2 — 16.2; fat 3.2 — 3.2 — 3.3, N-free extract 52.4 — 44.8 — 38.8; crude fibre 24.0 — 28.1 — 32.5.

The percentage of dry matter in the weeds studied ranged from 7.34-16.90, being below that found in meadow hay, red-clover and lucerne, but the sand-freed dry matter contained larger quantities of protein (17.31-27.78 %), fats (1.39-4.55 %) and crude fibre (13.25-19.68 %) than the last mentioned three plants; the percentage N-free extracts was, however, lower in the weeds (30.45-46.55). Thus, from their greater succulence, weeds fed green are of less value than fresh meadow hay, red clover and lucerne, but of greater value than these hays if fed dry.

The weeds under consideration withdraw from the soil large quantities of nutritive substances which must be carefully restored to the land.

Hoeing is the best method of controlling these weeds; should they, however, get the upper hand, they can be used as forage, but must not be cut too near the ground (in order to obtain them clean), and ought to be washed before they are given to stock. Any plants known to be injurious are naturally discarded.

The weeds studied all suited animals very well with the exception of *Mercurialis annua* which is always left untouched by grazing stock and rejected if mixed with hay. Owing to their large nitrogen and potash content (which reaches the very high figure of 10.9 % of the dry matter in *Chenopodium album*), all these weeds have a considerable manurial value.

TABLE I. — *Percentage of the chief forage constituents present in the weeds.*

Weeds	Dry matter in the weeds when first cut	In the sand free dry matter						
		Crude protein	Pure protein	Fat	N-free extract	Crude fibre	Ash	Phosphoric acid
<i>Convolvulus arvensis</i>	16.90	22.60	13.64	3.48	42.35	19.68	11.80	0.94
<i>Chenopodium album</i>	11.22	24.95	15.47	2.18	32.07	15.75	25.05	1.33
<i>Stellaria media</i>	9.22	24.08	16.16	2.05	38.18	14.93	20.76	1.60
<i>Cirsium arvense</i>	11.79	21.03	12.19	1.95	39.23	19.16	18.63	0.89
<i>Sonchus oleraceus</i>	9.39	19.94	12.54	4.49	40.69	15.55	19.33	1.12
<i>Mercurialis annua</i>	12.00	23.88	15.01	3.39	38.55	17.13	17.05	1.19

TABLE II. — *Percentage of substances nutritious to plants, present in the dry matter of weeds.*

Weeds	Nitrogen	Phosphoric Acid	Potash	Lime
<i>Convolvulus arvensis</i>	3.62	0.94	4.91	1.87
<i>Chenopodium album</i>	3.99	1.33	10.91	3.61
<i>Stellaria media</i>	3.85	1.60	10.93	1.99
<i>Cirsium arvense</i>	3.36	0.89	5.48	5.30
<i>Sonchus oleraceus</i>	3.19	1.12	7.82	2.92
<i>Mercurialis annua</i>	3.83	1.19	5.89	4.05

II. — *Experiments carried out in Great Britain in order to determine the value of fish-meal as a food for live-stock.* — The annual production of fish-meal in Great Britain exceeds the internal consumption. Most of this meal used to be given to poultry, but of recent years, it has been increasingly fed to other domestic animals.

The general average of nine recent analyses has given the following minimum, maximum and mean percentages: moisture 7.7 to 18.1; 12.9; albuminoids (protein): 51.1 to 63.1; 56.6; — fat 1.3 to 6.7; 3.71 — mineral constituents 20.8 to 28.0; 24.9 (these figures include: calcium phosphate 16.6 to 20.6; mean 18.8 — salt 0.6 to 5.3; mean 2.2) carbohydrates, crude fibre etc., 0.3 to 4.2; mean 1.9.

As a general rule, fish meal should only form one eighth of the ration, and when employed as a stock-feed, ought to contain no herring debris, or salt. If these precautions are observed, the meat of pigs given fish meal is of excellent quality, but if this care is not taken, the pork acquires an unpleasant smell.

No detrimental effect on the appearance, colour, odour and culinary value was observed in the case of the meat of the pigs used in experiments

at Leeds University, where fish-meal formed $\frac{1}{9}$ to $\frac{1}{7}$ of the total dry food, being fed during the last month at the rate of over 0.5 kg. per head and per day.

In the pig-feeding experiments conducted at the Rowett Research Institute, of Bucksburn, Aberdeen, tests were made with:

1) Fish-meal especially prepared for a stock-feed from fresh salmon waste (analysis: albuminoids 61.1; fat 2.3; inorganic matter 25.0; moisture 10.3; undetermined 1.3 %).

Results: No disagreeable smell, or taste, was imparted to the fresh, or salted, meat, even when the pigs had been fed the meal up to the time of killing.

2) Fish meal made of a mixture of salmon and herring waste (analysis: albuminoids: 62.2; fat. 6.4; inorganic matter 13.6; moisture 14.6; indetermined 3.2 %). Proportion fed $\frac{1}{7}$ of the ration.

Result: the meat of these animals had a disagreeable smell and taste.

3) Various commercial fish meals sold under the name of "White fish meal". Amount fed $\frac{1}{3}$ of ration.

Result: no unpleasant odour, or smell, was imparted to the fresh meat, even when the pigs were fed this meal up to the time of killing. The salted meat, however, had an unpleasant flavour in the case of animals that had received fish-meal up to less than 14 days before they were killed. If the fish meal had been discontinued for 14, or more days before the animals were killed, their meat was not affected. It may therefore be concluded that meal made from salmon refuse may be fed up to the time of killing in the case of animals of which the meat is to be consumed fresh, and up to 3 or 4 weeks before the time of killing, if the meat is intended for salting.

Fish-meals 1 and 2 were given to dairy cows (0.9 kg. per head and per day for two months), and also to hens: the milk from the cows, and the flesh and eggs of the fowls were not affected in any way.

The fish-meal manufacturers of Great Britain have agreed to produce a meal made only from salmon refuse to be sold under the name of "White fish meal", and having the following composition: albuminoids not below 55 %; calcium phosphate not below 16 %; fat not above 5 % salt not above 4 %.

In three experiments made in 1918-20, at the West of Scotland Agricultural College, fish meal of the above given type was used for fattening cattle at the rate of 600 gm. per head and per day mixed with rolled oats. The animals fattened well and their beef was excellent. Up to 1.4 kg. of fish meal per head and per day may safely be fed to milch cows, but care must be taken that the milker does not touch the meal just before milking, otherwise the milk acquires a disagreeable smell.

Owing to its high albuminoid and phosphate content, fish meal is especially good for calves. Recent experiments have proved the advantage of rearing calves on whey and a mixture of fish meal and meal, or milling offals; one parts of fish meal and two parts oat meal or middlings being given, for instance. In some trials made at Reading, the following mixtures were given at the rate of 500 gm. per 5 litres of whey:

linseed cake + bean flour + fish meal (3:3:1); 2) linseed cake + fish meal (2:1); 3) linseed cake + oat chaff + fish meal (3:2:1).

Horses may be given up to 0.9 kg. fish meal per head and per day; fish meal is especially useful when good hay is lacking and much straw has to be introduced into the ration.

Fish meal also forms a very good supplementary food for sheep on roots, and can be given to them at the rate of 150 to 200 gm. per head per day, and per 100 kg. of live weight. It is well suited to suckling ewes.

Chicks must not be fed fish meal until they are at least a week old, when this meal may form 5 % of the mash, the amount being afterwards increased gradually. Young fowls, can be fed the following ration: crushed oats + chaff + maize flour + fish meal (8:8:2:1). Laying hens may be given 10 to 15 % of fish meal in their mash which may be composed, for instance, of middlings maize flour + chopped lucerne or clover, hay + fish meal (3:3:3:1).

III. — *Non-albuminoid nitrogenous compounds for stock-feeding.* — Dr. PFEIFFER discusses the results of the extensive experiments conducted by HANSEN on feeding milch animals with a ration containing urea (1).

In the two series of experiments on dairy cows (in which urea was added to a ration poor in albuminoids, but containing sufficient starch values), the milk yield decreased little, or not at all; any slight decrease was attributed by HANSEN to a lack of easily soluble carbohydrates; PFEIFFER however does not discuss the matter.

The third series included 7 preliminary periods of 21 days each, and 14 periods belonging to the experiment properly so-called. In periods 1-3-5-7, the cows received sufficient albuminoids, but in periods 2-4-6, the latter substances were partially replaced by urea of equivalent starch value. Whereas during the first periods, the average live weight gain per head and per period was 7.75 kg., in the second series, the live weight decreased 3.33 kg. Hence, we have 11.08 kg. per head and 0.53 kg. per head and per day as the balance against the ration containing urea. In series 4, 5 and 6 of the experiment the balance against urea was respectively 0.62 — 0.14 — 9.77 kg. per head and per day. In series 7, a basal ration poor in albuminoids but containing sufficient starch values (period 1), was supplemented by urea (period 2) and by oil cake (period 3), in order to make its albuminoid content higher, and its starch value lower as compared with the two preceding series. In the urea period (8 days), the animals lost on an average 1 kg. per head, viz., 0.12 kg. per head and per day; in the oil cake period (12 days), they gained 9.5 kg. viz., 0.79 kg. per head and per day. Therefore, the balance against the urea ration was 0.91 kg. per head and per day. In the general averages of the series of experiments 3 to 7, the loss due to the addition of urea to the ration was 0.59 ± 0.88 kg. per head and per day.

This noticeable loss in live-weight can be explain by two hypotheses: 1) the tissues of the animals were consumed by the production of milk

(1) Summarised in R. 1922, No. 1194. (Ed.)

which contained crude protein and albuminoids in excess of the amount supplied by the food ; 2) some deposition, or loss, of fat had taken place ; the urea had probably been transformed in the digestive apparatus, by the action of bacteria, into albumin with the expenditure of much energy and consequent transformations in the carbohydrates.

Taking the first hypothesis as his basis, the author has estimated the weight of milk corresponding to the animals' loss of weight ; the amount of milk that could have been produced without any decrease in the live weight or any administration of urea + starch value and the amount of milk yield due to the urea + starch value. This latter amount was 35.5 % of the actual production, viz. less than 37 % of the milk supplied by a corresponding amount of albuminoids.

On the basis of these data and of the unit prices (as compared with that of urea), of various carbohydrate food-stuffs and of some oil-cakes, the author shows that the ration containing urea + starch value in part substitution of albumin costs more than the normal ration. Urea cannot economically be used as a food, but should be kept for a fertiliser, since the forage value obtained by its application is far higher than that of the same quantity of urea employed as a food-stuff.

IV. — *Experiments in feeding dairy cows with urea.* — These experiments were conducted at the Higher School of Agriculture, at Bonn-Poppelsdorf. The basal ration consisted of straw, chaff roots and slices, in alternate periods, 200 gm. per head and per day were given *in addition*. The results obtained were entirely satisfactory, for the addition of urea made a slight increase in the milk yield and the fat content, as well as in the weight of the animal.

V. — *The use and conservation of green forages and especially of the leaves of beets, etc.* — A brief account of the various methods of preserving green forages by means of drying and ensilage.

VI. — *Digestibility of the sugars, starches, pentosans and protein of some feeding stuffs.* — The work described by FRAPS in *Bulletin* No. 290 of the Texas Agricultural Experiment Station is a continuation of the experiments described in *Bulletins* 175 and 196 of the same Station. The first Bulletin treats of the digestibility and distribution of pentosans in the foods, and the second of the digestibility of the sugars, starches and pentosans present in roughage.

In Bulletin 172 of the North Carolina Experiment Station (1900) the author has passed in review the literature dealing with this subject published up to the present year, while in the Bulletin under examination, some recent important researches carried out in the United States are described.

The material used in this work was obtained from the digestion experiments described in *Bulletins* Nos. 166, 203 and 245 of the Texas Experiment Station.

The determination of the pentosans included the estimation of both the soluble and insoluble forms present in the N-free extracts and in the crude fibre. The residual NT-free extracts were determined by the addition of the sugars, starches and pentosans in the N-free extracts and by the subtraction of this sum from the total N-free extracts.

The average digestibility found for the different classes of forage is summarised in Table III:

Forages	Protein		Starch	N-free extract		Pentosan			Total
	non protein	Protein		total residue	soluble residue	Soluble in N-free extract	Insoluble in N-free extract	In crude fibre	
1. Non-leguminous hay and forage.	66.2	37.9	76.2	40.8	43.9	59.7	54.6	56.5	54.2
2. Leguminous hay	85.7	68.1	89.7	61.4	72.3	74.4	34.9	54.1	52.4
3. Concentrated starchy foods . . .	34.9	84.8	97.4	22.9	26.4	100.0	54.8	18.2	68.7
4. Derivatives from cotton seeds, maize bran and rice bran. . .	76.9	66.9	94.4	47.2	50.0	0	81.1	38.6	76.7

VII. — *Digestibility experiments.* — The composition of the different foods are given in Table IV, together with their production value, and the results of digestion experiments made on 2 sheep (data respecting some other feeds being also included).

TABLE IV. — *Percentage of certain feeds digested by sheep and their production value.*

Feeds	Digestibility coefficients					Production value in therms
	Protein	Ether Extract	Crude Fibre	N-free extract	Ash	
Lucerne *	74.2	44.9	48.3	72.49	49.5	39.2
Lucerne hay	75.3	34.8	46.2	68.8	49.9	39.7
Chopped lucerne hay	73.9	24.5	58.9	73.60	50.4	40.1
Red top sorghum.	56.5	56.4	100	87.4	59.3	76.8
Cotton-seed husks without down . .	0	76.1	46.1	65.0	0	36.3
Cotton-seed husks with down . . .	14.1	68.4	49.0	47.7	25.2	—
Maize bran *	58.2	76.6	50.6	77.2	8.5	70.9
Darso grain	72.5	87.2	80.6	92.2	46.1	—
Darso	64.5	78.1	49.4	88.2	—	87.2
Milo seed (whole)	87.9	88.2	72.3	95.6	73.4	90.9
Ground milo grain	84.0	91.2	2.3	95.9	31.1	90.1
Milo *	55.0	69.0	57.0	82.0	92.0	—
Rolled oats	90.2	95.7	79.9	98.1	41.6	99.3
Selected, whole Swedish oats . . .	77.0	89.0	36.0	81.0	—	70.9
Oat chaff	42.7	57.8	76.1	68.5	13.0	43.1
Oat milling offal	61.5	74.7	39.5	55.8	23.1	30.9
Ground nut shells *	52.8	89.0	12.0	57.6	20.8	11.3
Sesame cake	90.9	61.1	39.5	29.5	19.6	35.5
Wheat.	92.2	91.0	90.1	96.0	79.2	89.2
Wheat bran *	84.3	80.6	43.3	77.4	44.5	54.4
Dark shorts	89.1	83.2	61.4	86.9	44.8	77.8
Rolled wheat.	90.3	86.5	88.1	96.1	82.1	—
Grey shorts	82.6	95.5	0	89.5	28.9	77.3
White shorts	80.0	91.5	33.5	98.9	70.1	92.3

* Average of several experiments.

VIII. — *The marketing of mill feeds.* — The author, Investigator in Feed Marketing, Bureau of Agricultural Economics, Office of Rural Economy of the Department of Agriculture of the United States, examines the organisation (from the mills to the purchaser) of the complicated trade of the by-products of milling in the United States, whether this organisation is the work of dealers or of wholesale, or retail, buyers, or of purchasing co-operatives. He treats of the commercial laws regulating this trade, the grades of the various feeds, the method of studying the condition of the market and of ascertaining the quoted prices, the laws governing this trade in the United States and the present needs of the trade.

Purchasing co-operatives, when first started, preferred to buy their goods as soon as they arrived viz. after they had been inspected, rather than from the millers who insisted upon payment on delivery or before the goods had reached their destination. Now, however, that the millers are willing to make good any reasonable claim arising from the quality of the commodities received, they always prefer to buy from the millers direct.

The average difference between the sale price asked by the miller and the retail seller respectively amounts to about 10 dollars per ton, not including carriage, which is not excessive allowing for the expense of storage.

A car-load is 20 tons net. The Official Association of Feed Control in the United States recognises the following classes of feeds, which unless special arrangements are made to the contrary, are generally recognised and accepted by the trade: Wheat bran — standard middlings, — red dog flour, a mixture of low grade flour and fine bran — wheat mixed feed (a mixture of bran and standard middlings in the proportions obtained by ordinary milling) — wheat bran and standard middlings (a mixture of the two latter in the proportions obtained by ordinary milling) — screenings — scourings. F. D.

403. **Breeding Horses, and Sheep in Chili.**

I. — NOË. Origen del caballo chileno. Causas de su decadencia. Resurgimiento. *Boletín de la Sociedad Nacional de Agricultura*, Vol. LIII, No. 10, pp. 657-659. Santiago de Chile, 1922.

II. — ENCINA F. A. (Presidente de la Sección de Razas Caballares de Silla, Sociedad Nacional de Agricultura de Chile). Observaciones sobre la formación y el desempeño del Jurado de caballares chilenos. *Ibidem*, pp. 659-676. figs. 3.

III. — PRADO, U. Característica de la explotación del ovejuno en Chile. *Ibidem*, pp. 682-688, figs. 6.

I. THE CHILIAN HORSE. — This horse is descended from the Spanish war horses of Arab blood that were imported into Chili in large numbers at the time of the conquest, but the successive introduction of other foreign breeds, for which the best Stud-Stations and breeding conditions were reserved, caused the deterioration of the original Chili horse. About 1880, however, under the auspices of the "Sociedad nacional de Agricultura", the reconstitution of the old valuable breed was commenced, and

its pure-bred, or half-bred, products now form the basis of the Army Remounts Service. The Stock has rapidly improved since 1910, so that Chilean horses are now in favour in countries where horse-breeding has reached a high level.

II. — JUDGING THE CHILIAN HORSE. — The author describes the difficulty of judging Chilean horses entered at Shows, or Competitions, and reminds his readers that an individual examination is only exceptionally made in the above cases owing to the discredit into which it has fallen on account of the bad results obtained from the application of the decimal scale. He points out the necessity for the judges always to bear in mind the standard type of the breed, which he describes in detail: *head* light, of average breadth, with broad, flat forehead, profile rectilinear, or slightly convex; *neck* of medium thickness; *withers* low, but very muscular; *dorsolumbar line* straight; *croup* wide and full, slightly sloping towards the tail; *chest* broad and deep; *barrel* circumference multiplied by itself and divided by the height of the withers gives about 2.2 viz. a little over the proportion of the Crevat (2.1125), this insures fairly rapid movement combined with speed since the Chilean horse has low withers; *shoulders* straight and muscular (frequent defect, too great development of muscle); *hock* relatively shorter than in other breeds etc.

III. — CHARACTERS OF CHILIAN SHEEP-BREEDING. — Sheep are bred on the long, narrow coast zone which is infertile, or of average fertility. The irrigated zone (central valley), is not suited to sheep rearing, either from its excessive humidity, or because it is more profitable to breed other stock there. The sheep are chiefly grown for mutton, of which the demand exceeds the supply. For this reason, early maturity is the quality most appreciated, and is obtained by crossing the native animals with English black-faced breeds.

In the provinces to the north of Valparaiso, lambs born in June-July are sold to the butcher from September to October, in the South-Central district, they are sold from October to November, and in the South from December to March; this difference is connected with the growth of the spring vegetation in the various latitudes. In autumn, the market is well supplied with goats and castrated sheep imported from Argentina, while in the winter, the animals offered for sale are imported sheep, or the rejected individuals from the Chilean flocks which have first been castrated, collected and sent to fatten in the central valleys either on the irrigated land that has already been grazed by the cattle, or more frequently, in the vineyards after the vintage. These flocks also include the latest born lambs "marzoles" (those dropped in March).

In the selection of breeds for the improvement of the native sheep, all fat sheep requiring richer pasture than is usually found in Chili must be avoided. The author recommends Southdowns and Suffolks; Hampshire Down and Oxford Down sheep only find suitable conditions in the Central districts; in the southern part of Chili, where there is too much rain for black-faced breeds, Lincoln and Kentish sheep do very well.

Wool is a secondary product of the Chilean sheep-breeding industry; as the animals are shorn twice a year, the conditions are unfavourable

to the Merino which otherwise would have been the best sheep for improving the native stock. It would suit the provinces north of Valparaiso but for the fact that an abundant supply of forage cannot be obtained there throughout the year. This difficulty might, however, be overcome by the rapid spread of "pasto salobre" (1) (*Atriplex semibaccata*) which is thoroughly acclimatised.

The national breed of sheep known as "Lignana", or "oveja de Lignas" is distinguished by its long, dense fleece, that is usually self-coloured: dark-yellow, golden, roan, white, black, etc. The fleeces of these sheep have always been highly valued, and now realise as much as 50 dollars each.

F. D.

404. Studies in Swine-Feeding.

I. — POULAIN, A. (Directeur du Centre régional d'élevage porcin des Milles, Bouches-du-Rhône). Centre d'élevage porcin des Milles. *Office régional agricole du Midi, Bulletin trimestriel*, No. 4, pp. 1-25. Marseilles, 1922.

II. — OTTO. Die Kentabilität der Schweinemast. *Deutsche landwirtschaftliche Tierzucht*, Year 26, No. 52, pp. 553-554. Hanover, 1922.

III. — WILLIAMS, D. W. and McCONNELL, O. E. Rice Bran for Fattening Hogs. *Texas Agricultural Experiment Station, Bulletin* No. 286, 15 pp. College Station, Brazos County, Texas, 1922.

IV. — MÜLLER and RICHTER. Weideversuch mit Lauferschweinen auf Rieselgras und Serradella mit verschiedenen Beifutter. *Zeitschrift für Schweinezucht*, Year 29, Part 22, pp. 343-345. Neudamm, 1922.

V. — Ist es zweckmässig, die Ferkel mit sechs Wochen abzusetzen, oder ist ein späterer Termin besser? *Ibidem*, Year 30, Part 2, pp. 17-21, 1923.

I. — Studies in Swine-Breeding carried out at the *Centre d'élevage porcin des Milles* (Bouches-du-Rhône, France). These include an account of the Marseille breed and feeding experiments.

The Marseilles (2) breed of pig is distinguished by hardiness and fertility and the sows give a full flow of milk. POULAIN hopes by means of systematic selection to be able before long to make it one of the favourite types of swine. Even now, the industrial cross between the Marseilles and Large White provides a very considerable number of animals for fattening.

The feeding experiments conducted in 1920 included: *The determination of the heating properties of certain foods*. On the basis of the consistency of the excrement of pigs fed on various foods, the author classifies the latter as follows:

- Constipating: groundnut cake, sesame cake;
- Neutral: pulse meal, palm-oil cake, maize flour;
- Cooling: bran, barley, sorghum;
- Laxative: copra, rice-flour;
- Irritant or too laxative: raw manioc.

(1) See R. 1922, No. 46. (Ed.)

(2) See R. 1921, 1148 (Ed.)

Feeds have therefore physiological properties that are independent of their composition, so a well-balanced neutral ration can be obtained by mixing them according to their heat causing quality. Taking as his basis the excess or deficiency of faeces as compared with the normal the author obtained the following figures per unit weight of feed: groundnut cake +8; sesame cake +7; legume and maize flour and palm-oil cake +1; bran and barley -1; sorghum -2; copra-cake and rice flour -5; raw manioc -8.

Nursing ration. — The maintenance ration of sows (live weight 100-120 kg.) is bran 1.2 kg. + palm-oil 1.2 kg. + lucerne, cabbages, or pumpkins kg. 2.5. Good results have not always been obtained by using this ration with the addition of 0.6 kg. groundnut cake for nursing sows, but the substitution of 1.7 kg. of bean meal or maize flour for the palm-oil cake has in all cases proved satisfactory and the use of this ration checked diarrhoea among the sucking-pigs.

Feeding piglings at grass. — Young weaned pigs turned out into a field of grass and clover and fed a mixture of equal parts of wheat bran and palm-oil cake weighed 30 kg. after three months, their average daily live-weight increase being 433 gm. per head.

The work done in 1921 included: *Experiments in feeding manioc to pigs.* The manioc was given raw in strips and either soaked or dry, and took the place of cereals in a ration including palm-oil cake and bran. The manioc was incompletely digested and caused severe diarrhoea in the case of the young animals weighing about 50 kg. and also in the piglings suckled by sows fed this ration. The diarrhoeae stopped as soon as cereal flour was substituted for the raw manioc. When ground and cooked, however, manioc caused no intestinal troubles.

Feeding pigs on sorghum. — Summarised in R. March, 1922, No. 296.

Experiments with different mixtures. — One pig given a mixture of: 1.2 kg. sorghum + 0.3 kg. groundnut cake + 0.45 kg. bran + 0.09 kg. bone meal during the first period (the amount of groundnut cake and of bran being raised during the second period), increased on an average 521 gm. daily in live-weight during the first period and 421 gm. during the second period. Thus, the effect of substituting groundnut cake for part of the bran in the ration of young pigs is to check their increase in live-weight.

Experiments with bone-meal. — Bone-meal when fed to young, growing pigs reduces the cost of meat production, but the animals develop very slowly. The addition of 90 gm. of bone-meal to the daily ration of pigs weighing 35-50 kg. has the effect of producing a further average live-weight increase of 1.2 kg. per head and per week and of savings 10 % on the food required to give 1 kg. of meat.

2) *Feeding bone-meal to sows in farrow* caused an increase in the weight of the piglings at birth, their more rapid growth during the suckling period (1 kg. extra weight at weaning) and 16-20 % less decrease in the weight of the nursing sow. These results were obtained by the addition of 100 gm. of bone-meal to a ration of 1 kg. palm-oil cake + 1 kg. bran during the gestation period, and of 1.5 kg. to 1.5 kg. of these feeds

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per sow of 100 kg. during the suckling period. Other experiments carried out in 1922 included:

Feeding tests with fish-meal: 1) In the case of growing animals, fish-meal fed at the rate of 200 gm. per 1200 gm. of other food (bran, cereal flour, palm-oil cake) increases the digestive return, that is to say, the proportion of meat produced to food consumed, by about 25 %.

2) By adding 200 gm. of fish-meal to the ration of a sow in farrow fed 1.1 kg. palm-oil cake + 1.1 kg. bran, and 300 gm. to the ration of a nursing sow (1 kg. palm-oil cake + 1 kg. bran + 1 kg. maize) the weight of the piglings at birth was increased by 100 gm. or more, and the loss of weight by the sow during the suckling period fell 30-40 %, while the health of the piglings was better and they put on more weight.

The fish-meal used contained 13 % moisture and fat and 3-4 % of salt and produced no digestive troubles.

Experiments with sesame cake. — This cake has long been successfully fed to sheep in Provence and the author found that it could be used with equally good results for sows. Sesame-cake when given in the place of the usual amount of groundnut cake to nursing-sows prevents the sucking-pigs being troubled with diarrhoea, while mixed with fish-meal (bran and maize flour 2 kg. + palm-oil cake 1 kg. sesame cake 0.3 kg. + fish-meal 0.3 kg.) it prevents loss of weight in the sow during suckling and increases the little pigs' rapidity of growth. The constipating character of this cake must however not be forgotten.

II. — THE PROFIT OBTAINED FROM FATTENING SWINE. — Dr. OTTO is strongly of opinion that it is necessary in the interests of German Agriculture that pigs should be fattened without using imported foods for the purpose, and to prove that this is possible, he describes three experiments carried out at the "Göttingen Hochschule für Ackerbau" by Prof. LEHMANN.

One lot of pigs of improved German breed ("veredelte Landschweine") was fattened for four weeks and during the period the average consumption per head was: fine maize and barley bran 295.4 kg. + fish-meal 26.6 kg. the average increase in live-weight obtained was 84.7 kg. per head. Another lot of pigs consumed in four weeks 105 kg. of barley + 42 kg. fish-meal + 802.5 kg. potatoes and increased 88.8 kg. in weight per head. The third lot ate 105 kg. bean bran + 10.5 kg. barley bran, which was fed during the first week only + 844.2 kg. potatoes + grass *ad lib.* and increased 88.2 kg. per head in 5 ½ weeks. The pigs of the third lot took longer to fatten, but as they were not fed imported foods such as maize and fish-meal and therefore cost less, they alone under existing conditions gave any margin of profit.

III. — RICE BRAN FOR FATTENING SWINE. — The work of WILLIAMS and MCCONNELL was divided into two series of experiments: 1) to determine the food value of rice bran fed in different proportions with whole flour and meat-meal; 2) to discover the effect produced on the quality of the fat of the carcass by giving rice bran in various proportions mixed with whole maize flour and meat-meal.

Twenty-four Duroc-Jersey pigs divided into 12 lots were used in the

experiment. Six of the lots had first been turned out to feed for about 25 days on groundnuts. The feeding tests lasted 75 days. Each ration was given to 2 lots of which one had been feeding on groundnuts. All the lots had access to a small yard during the experiments.

The results obtained are summarised in the following table.

Lot	Ration feed			Average weight per head		Average daily increase per head	kg food consumed per 100 kg increase in live-weight		
	Maize flour	Rice bran	Meat meal	Initial	Final		Maize flour	Rice bran	Meat meal
	%	%	%	kg.	kg.	kg.	kg.	kg.	kg.
1.	90	—	10	71.7	135.3	0.54	401.4	—	44.6
7.	90	—	10	57.9	116.2	0.77	375.3	—	41.7
2.	—	40	10	70.4	114.9	0.58	—	449.1	49.9
8.	—	40	10	57.2	98.5	0.55	—	456.3	50.7
3.	45	45	10	71.7	122.0	0.67	247.0	247.0	55.0
9.	45	45	10	57.2	114.4	0.76	195.3	195.3	43.4
4.	ad. lib.	ad. lib.	ad. lib.	72.2	141.2	0.62	506.0	47.0	6.0
10.	ad. lib.	ad. lib.	ad. lib.	58.1	121.7	0.84	401.0	29.8	9.2
5.	30	60	10	72.6	127.6	0.73	148.5	297.0	49.5
11.	30	60	10	59.5	108.0	0.65	147.6	295.2	49.2
6.	60	30	10	73.5	135.7	0.83	282.6	141.3	47.1
12.	60	30	10	57.2	115.5	0.77	253.3	120.9	42.3

Rice bran added to a ration consisting of meat-meal only (lots 2 to 8) does not yield satisfactory results, for the mixture is unappetising and the increase in live-weight is slower. Fairly satisfactory results can however be obtained by introducing a little maize flour as well as the rice bran.

At the end of the experiment, three animals from each lot were sent to be slaughtered at the United States Experiment Station at Beltsville, the remainder were sent for the same purpose to Messrs SWIFT and Co., Fort Worth, Texas. After 48 hours' refrigeration, the carcasses were classified at both places. Messrs SWIFT classed as "soft": 4 in lot 2; 5 in lot 8; 1 in lot 9; 2 in lot 5; 1 in lot 12 and 1 in lot 6.

At the Beltsville Station, 2 carcasses of lot 8 were described as "a little soft". Thus 50-60 % rice bran may be fed with maize flour and meat meal without inducing softening of the tissues.

Pigs can safely be turned into a groundnut field for some time previous to fattening since this pasturing has no effect upon the firmness of their flesh as was found by an examination of the groundnut grazing and control lots respectively.

IV. — COMPARISON BETWEEN IRRIGATED MEADOW GRASS AND SERRA-DELLA WITH VARIOUS SUPPLEMENTARY RATIONS AS FEEDS FOR FATTENING PIGS (I). — Experiments made by the "Versuchswirtschaft für Schweine-

(1) See R. 1922, No. 1081 and 1347. (Ed.)

haltung-fütterung und zucht." (Pig-breeding Station) at Ruhlshdorf (Tellow). 64 pigs, 4-7 months old, belonging to the common walking breed and of an initial weight of 30-50 kg. were divided into two lots one of which was turned into a field of Italian rye-grass (*Lolium italicum*) and the other into a field of serradella. The rye-grass meadow was irrigated with sewage-water and divided into plots of 30 ares which were grazed successively, the grass never being allowed to grow to a height exceeding 15 cm. Each plot was grazed 6 times a year. The two lots of pigs were each divided into two groups the first of which (No. 1 in the rye grass field and No. 3 on the serradella), received 1 kg. per head and per day of a mixture containing 10 kg. maize bran + 1 kg. meat-meal + 0.2 kg. lime while the other (No. 2 on the rye-grass meadow and 4 on the serradella field) were fed 0.25 kg. of the same mixture + 3 kg. of potatoes per head and per day.

The experiment lasted from September 25 to October 23, 1922. The average daily live-weight increase per head in the 3 groups was respectively 337-388-389-388 gm. The gain on the serradella field was thus the larger, as was to be expected seeing that this plant is leguminous, the proportion being about 5 : 6, but the increase in live-weight in the group grazing on the irrigated rye-grass was quite satisfactory. The first of the two supplementary rations proved the better, but the difference was not great. Taking 4 kg. of potatoes as equivalent to 1 kg. of the mixture of concentrated foods, described above, the various groups required the following amounts of concentrates to make 1 kg. increase in live-weight : 2.97-3.05-2.59-2.58 kg. or an average of 2.80 kg. Ordinary breeds of pigs as a rule consume 4 kg. of concentrates to produce 1 kg. increase in live-weight. Therefore the consumption of concentrated foods in this experiment was very small which proves the great value of pasturing.

V. — SHOULD PIGLINGS BE WEANED AT 6 MONTHS OR LATER. — As a result of experience acquired at the Versuchswirtschaft für Schweinehaltung-fütterung und Zucht at Ruhlshdorf (Teltow, Germany) the author advises that piglings should be suckled up to the tenth week, but that the sow should be served by the boar as soon as she is in heat. It is erroneous to suppose that the milk of a fertilised sow contains substances injurious to sucking-pigs. The sow does not become excessively thin during the nursing period, provided she is liberally and suitably fed. Both seller and buyer benefit from the extension of the suckling period beyond 6 weeks, for the piglings fetch a better price and the increase in live-weight is more rapid. As a rule, the weight of nursing sows decreases considerably until the fourth week, after which it remains about the same to the sixth week, and increases from the seventh to the tenth week till it almost reaches the weight of the sow after farrowing. Piglings are much heavier at 10 weeks than at 6 weeks. Increasing the suckling period decreases the amount of concentrated food required to produce 1 kg. increase in live weight in sow and litter, which in the case of a Yorkshire sow was 2.95 — 2.81 — 2.78 kg. respectively for nursing periods of 6-8-10 weeks.

F. S.

405. **Studies on Poultry Feeding.**

I. — SCHOFIELD, M. A. Feeding Milk to Poultry. *The National Poultry Journal*, Vol. LXII, Part, 3, No. 116, p. 151. London, 1922.

II. — WOOD, D. Feeding the Heavy Layer, How to Supply the Essentials to Heavy Production. *Ibidem*, No. 117, pp. 164-165.

III. — BOSSERT, A. The Rational Feeding of Poultry. *Ibidem*, No. 126, pp. 295-297; No. 127, p. 305.; No. 128, p. 319.

IV. — DOBBIN, R. C. H., Some Lancashire Experiments. Wet versus Dry Mash. *Ibidem*, No. 131, p. 363.

V. — HEPBURN, J. S., HOLDER, R. C., and others. Rations for Feeding Poultry in the Packing-House. *United States Department of Agriculture, Bulletin* No. 1052, 24 p. Washington, 1922.

I. — FEEDING MILK TO POULTRY. — The by-products of milk (skim milk, whey butter, or condensed milk or whey, whether liquid, or in powder), have proved most useful in the feeding both of chicks and of adult fowls. Powdered milk must be dissolved before use in ten times its weight of water. Its nutritive value, if equal weights are taken, is the same as that of meat-meal.

Skim milk can be fed either fresh, or sour. It is a mistake to attribute the efficacy of skim milk or whey solely to the lactic acid they contain and to believe that lactic acid can be substituted for the above substances, although a small dose of lactic acid is very good for chicks, as it not only acts as a mild disinfectant of the digestive canal, but is also a stimulant and an excellent remedy against coccidiosis and other diseases. If however, an excessive amount of lactic acid is given, it does serious injury by destroying the mucous membranes; further, it is of no use in the feeding of adult fowls when a well-balanced ration is given. Hence, it is best to reserve lactic acid for a medicine, and to use for food purposes only the by-products of milk.

Skim milk, whey, and a solution of powdered milk are put into the drinking-troughs. The acid solution is made into a mash. Milk powder can also be added to the mash in the proportion of 5 to 10 %. About 5 litres of mash per day is enough for 100 fowls. The whey, or solution of powdered milk, should be fed at the rate of at least 5 litres a head for 100 head. By products of sweet, and of acid, milk ought not to be given at the same time, but may be fed on alternate days.

From the results of his experiments, SCHOFIELD concludes that non-acid milk by-products suit young fowls better than acid ones which ought to be used as a condiment rather than as a food.

II. — FEEDING THE HEAVY-LAYER. — WOOD has studied the application to the feeding of heavy-layers of our modern knowledge respecting the effect of the mineral constituents and the vitamins in the different feeds. As a result of his own experience, he suggests the following ration: equal parts of wheat and oats; mash middlings + bran + gluten + fish-meal + chopped clover, or lucerne-hay + dried yeast + soy-bean meal + ground oats (4:4:4:2:2:1:1). Once in 3 weeks, 2 %

of salt should be added to the mash, and once a fortnight 1 % (by weight) of crude cold-liver oil may be introduced.

III. — THE SCIENTIFIC FEEDING OF POULTRY. — A hen that is not laying should be fed, in order for the ration to be well-balanced, for every 100 parts protein 452 parts of carbohydrates and 20 parts of fat. A hen laying 1 — 2 — 3 — 4 — 5 — 6 — 7 eggs weekly, ought to consume respectively, for every 100 parts of protein, 421 — 394 — 375 — 362 — 347 — 336 — 327 parts of carbohydrates, and 26 — 30 — 33 — 36 — 39 — 41 — 43 parts of fat. In calculating the ration of a laying fowl, BOSSERT advises that the egg production should be estimated at 5.6 eggs per week, viz., the ratio should be 100 protein : 340 carbohydrates : 40 fats, or in the simplest terms, 10 : 34 : 4.

The following rations fulfil all these conditions per 10 head and per day :

1) Middlings 280 gm. + meat-meal 80 gm. + wheat 370 gm. + maize 110 gm. + hemp-seed 110 gm. + bone-meal 14 gm. + green food (grass and roots) 800 gm.

2) Middlings 200 gm. + fish-meal 100 gm. + wheat 400 gm. + maize 100 gm. + hemp-seed 140 gm. + bone-meal 14 gm. + green food 800 gm.

The grain is given separately, but at the same time as the other substances (which are mixed into a mash) both morning and evening ; the green food is given midday.

IV. — DRY VERSUS WET MASH. — This paper gives an account of various experiments described and discussed at a meeting of the Lancashire Utility Poultry Society. Most of the experiments had been carried out on the County Farm, at Hutton, and show that wet mashes should not be discontinued, but given alternately and supplemented by grain fed separately, and by green food.

V. — FATTENING RATIONS FOR POULTRY. — When, as is the case in the United States, poultry are sent long distances, they should not be fattened by the rearer, as the birds lose their finish on the journey, and the sender cannot dispatch them as frozen meat. Therefore, the poultry rearing industry has to be divided into two branches, the production and fattening branches respectively. Fattening takes 1 to 2 weeks and is carried out at the packing-houses.

Poultry-fattening as a specialised industry is making rapid progress in the United States ; this induced the author to carry out his investigations in the Food Research Laboratory of the Department of Agriculture of the United States. He compared different rations and determined : 1) the increase in live-weight obtained ; 2) the improvement in the edible portions of the fowl.

Two kinds of experiment were carried out ; in the first, various tests were made for each ration with 12 fowls fed and studied separately.

In the second class, the so-called Battery experiments, a large number of fowls (up to over one thousand in a lot), were studied in flocks. The rations fed the control lot consisted of maize-flour and butter-milk (40 : 60). In the experiment rations, part of the maize-flour and of the butter-milk

was replaced by one, or more, of the following foods: barley, maize-flour — whole oats — entire oat meal — oat-meal patents — ground oats — rice bran — rice husks — ground rice — wheat offals — wheat middlings — coconut cake — ground decorticated ground-nut cake — undercorticated ground nut cake — colza cake — soy-bean cake — kafir — ground milo — lucerne — meat scraps — condensed whey — powdered whey. The fowls were weighed on the 1st, 4th, 8th, 11th, and 14th days of the experiment.

One table gives the composition of the foods used, the other 12 give the results of the experiments.

The averages of the most important results are to be found in the following table.

Classes of birds	No. of birds per class	Increase in 4 days		Increase in 8 days		Increase in 11 days		Increase in 14 days
Cockerels	612	12	30	23	57	31	78	40
Pullets	396	—	—	17	60	24	85	20
Adult cocks	336	11	50	17	77	21	93	22
Hens	456	4	34	8	65	10	84	12

The younger birds (cockerels and pullets), increased most rapidly in live weight when given a concentrated protein food such as cake, or meat scraps. The hens did not give uniform results, from which it would appear that meal suits them as well as a concentrated protein food.

The best length for the fattening period depends to a great extent upon circumstances. A fortnight is certainly not too long for cockerels, since they continue increasing in weight rapidly for this time; whereas pullets gain all their weight in 11 days. In the case of adult cocks and hens, the fattening period must be limited to 6-8 days.

The analyses made of the different parts of the body of a large number of birds belonging to the various classes showed no difference produced by the rations on the composition of the edible portions, or the dressing losses, although the classes differ perceptibly in both these respects.

The yield of edible portions (in % of live weight) was for unfattened and fattened birds respectively: cockerels 56 and 60 — pullets 63 and 67 — cocks 62 and 64 — hens 70 and 71, which shows the advantage of fattening. In the last chapter is given the composition of rations for fowls that are to be fattened.

F. D.

406. Studies in Silkworm Breeding.

I. — SECRETAIN, M. (Chef de Travaux à la Station Séricicole de l'École Nationale d'Agriculture de Montpellier). Notes séricicoles. Essais d'élevage des vers à soie du mûrier avec la feuille de scorsonère. Essais d'élevage des vers à soie du mûrier avec la feuille de Maclura. Étude sur la grasse. Bibliography. *Annales de l'École Nationale d'Agriculture de Montpellier*, New Series, Vol. XVII, Part III, pp. 191-216.

II. — GRANIER (Direction des Services agricoles de Dignes, Basses-Alpes). Essais sur le débitage des vers à soie. *Office régional agricole du Midi, Bulletin trimestriel*, No. 2, pp. 48-54; No. 4, pp. 46-53, figs. 3. Marseilles, 1922.

III. — LOMBARDI L. Bozzoli aperti del baco da seta in condizioni anormale di alimento. *Bollettino della R. Stazione sperimentale di Gelsicoltura e Bachicoltura di Ascoli Piceno*, Year II, No. 1, pp. 12-16, figs. 2, Ascoli Piceno, 1923.

IV. — LOMBARDI, L. Sulla determinazione del sesso nel *Bombyx mori*. *Ibidem*, pp. 1-7.

V. — ACQUA, C. Se il radio eserciti un'azione sullo sviluppo della pebrina. *Ibidem*, pp. 8-12.

VI. — ACQUA, C. L'esame delle ali è sufficiente per la ricerca d'infezione della pebrina? *Ibidem*, pp. 39-43.

VII. — ACQUA, C. Per l'incremento della gelsicoltura e bachicoltura in rapporto anche all'utilizzazione di zone malariche. *Ibidem*, pp. 17-30.

I. — In 1920, SECRETAIN made an experiment in rearing silkworms on the leaves of the viper's grass (*Scorzonera hispanica*) (1) with a view to obtaining if possible 3 broods in one year from an annual breed of silkworms, viz. a winter brood on viper's-grass, a normal brood on mulberry leaves and an autumnal one on mulberry leaves. The results were however negative for nearly all the caterpillars died of jaundice, and it appears from a study of the literature dealing with the subject that most of the results obtained by previous investigators were also negative.

Similar results, with a single exception were produced by feeding the larvae on *Maclura*.

These failures cause the author to conclude that one of the causes of jaundice is unsuitable food (2). His numerous enquiries have shown, *inter alia*, that the granules characteristic of the disease vary in shape, being octohedral in silkworms fed on mulberry leaves, and generally trihedral for those reared on the leaves of *Maclura*.

The bibliography at the end of this article contains 50 works.

II. — As a result of investigations in the Centre Régional de Sériciculture of Oraison (Basses-Alpes, France) GRANIER found that the bedding of the silkworms loses through evaporation 29 % of its initial weight the first day; 23 % the second, and 18 % the third; this means a loss of 60 % in three days, which is equivalent to 30 % of the weight of the leaves given to the silkworms. Estimating the moisture content of 1 m³ of air at ordinary temperature to be 5 gm. of water, the ventilation of a silkworm-rearing shed should be so arranged as to allow 67 m³ of air to pass through in 24 hours in order to absorb the moisture given off by each kg. of leaves fed, if the bedding is changed once in 3 days. If the bedding is removed daily, it is possible to reduce by about one-half the volume of air generally considered necessary for the success of silkworm-rearing operations.

(1) See, R. 1921, No. 749. (Ed.)

(2) See R. 1922, No. 1090 (Ed.)

On determining by means of a hygrometer the water-vapour distribution in the incubation rooms, it was found that silkworms lying on irregularly changed litter placed on an impermeable surface were surrounded by a damp atmosphere highly conducive to the outbreak of disease. Hygienically it is better to use a cloth instead of a grating and to renew the bedding daily.

One of the chief difficulties in silkworm rearing in France and other European countries is the dearth and high cost of labour, and the author describes in detail a stand of his own invention with automatically moving gratings by which the work is much lightened. The basic principle of this apparatus is the use of at least two surfaces moving and changing positions independently of each other. One of these surfaces is unperforated and serves as the breeding-tray properly so-called, the other which is composed of a large-meshed network forms a provisional support for the fresh litter and for the caterpillars resting temporarily on the other surface. The unperforated surface consists of an endless cloth, and the grating is made of wire-netting carried by a winding and unwinding drum respectively which are connected so as to render all the operations as rapid as possible and capable of being carried out by the minimum number of workers. The author calculated that the hatching and rearing of 20 ounces of silkworm-eggs would need 440 days' work if the bed were changed every 3 days, 480 if renewed twice in 3 days, and 640 if it every day, as against the 80 days required for renewing the bed daily by means of the new mechanical apparatus.

III. — By feeding silkworms on mulberry leaves sprinkled with a mixture of equal parts of starch and powdered sulphur, LOMBARDO obtained cocoons open at both ends and of a structure recalling that of various wild species, though these are only open at one end.

IV. — LOMBARDO made use of silkworms to test the truth of the theory that the fertilisation of ova as soon as they are mature results in an almost equal number of female and male caterpillars, while the fertilisation of hypermature eggs gives a larger proportion of male caterpillars. He mated a male moth with females that had just emerged from the cocoon or for 1-2 and 3-5 days respectively, obtaining in the 5 cases 49 — 50 — 57 — 61 — 65 % of male silkworms, and 51 — 50 — 43 — 39 and 35 % of females. The theory would thus appear to be confirmed.

V. — Prof. ACQUA stated in reports published in 1914 that radium emanations arrest the development of silkworm-eggs and finally destroy them. In recent experiments undertaken to ascertain whether radium exercises any influence on the development of pebrine, he only obtained negative results, the spores of *Nosema Bombycis* being much more resistant to radium than the eggs of *Bombyx mori*. He also found that radium causes the eggs of silkworms to hatch at unseasonable times.

VI. — Prof. ACQUA states that he was able to detect the pebrine corpuscles quite distinctly in the blood that exuded from half a wing (cut off a living female moth) when compressed between a slide and cover-glass. At least half a wing must be used for unsatisfactory results are always obtained from the examination of only the edge of the wing. This method had

previously been suggested by several other investigators; Dr. FOA of the Istituto Bacologico of Portici (Naples) found it perfectly reliable, and some firms have adopted it with complete success. In one case, the comparative examination of pebrine by the wing method and by means of cell-selection gave wholly concordant results.

VI. — During the silkworm-rearing season, malarial zones, even where no drainage operations have been carried out, are quite healthy for man. Prof. ACQUA suggests that they should be planted with mulberry-trees grown as bushes, or low shrubs for silkworm rearing, the ground being ploughed at the beginning and the mulberries planted at the end of the winter. The returns would certainly pay for the simple plant needed for the purpose.

F. D.

General.

407. Purification of Watering Places and Maintenance of Ponds.

GRAU, A. L'assainissement des abreuvoirs. *Revue de Zootechnie. La Revue des Éleveurs*. Year 3, No. 4, pp. 275-277, 1 fig. Paris, 1923.

The author describes the following harmless and inexpensive method of disinfecting contaminated water: dissolve in a bucket of water, a sufficient amount of the following mixture: permanganate of potash: 0.025 kg., + sulphate of aluminium: 0.250 kg., + washed kaolin: 0.275 kg.; 1 kg. of this mixture is sufficient for the purification of 5 cub. m. of water. The bucket should be plunged into the liquid and alternately raised and lowered for 3 to 4 minutes so as to obtain as complete a stirring and churning up as possible.

Disease germs and micro-organisms will be killed by the permanganate of potash; the matter in suspension will be collected by the sulphate of aluminium and precipitated by the kaolin. Four days at least are required for clarifying the water. A yellow tinge after treatment indicates the presence of much organic matter but is not dangerous.

A solution of 2 % of permanganate of lime in the proportion of $\frac{1}{4}$ of a litre per cub. m. of water may also be poured into the pond and the water stirred, adding the following day 6 to 7 gm. of powdered charcoal per cub. m. of water.

Instead of the permanganate of lime, "Javel" water can be used in the proportion of 1 litre per cub. m., adding after an interval of 4 to 5 days, 100 to 150 gm. of powdered charcoal and 100 gm. of slaked lime per cub. m.

To keep the bottom of the ponds free from leakage after the cleaning process, it is necessary to add to the water, as soon as it has returned, 20 gm. of sulphate of aluminium per cub. m., and two days later 4 gm. of slaked lime; in 8 days time the bottom of the pond will be sufficiently water-tight.

F. S.

408. **The Migrations of the Tsetse Fly.**

CHORLEV, J. K. (Assistant Entomologist). Tsetse Fly. Eastern Border. *The Rhodesia Agricultural Journal*. Vol. XIX, No. 6, pp. 680-682. Salisbury, 1922.

The author has observed that in Rhodesia the area of the region infested by the tsetse-fly has greatly decreased since 1919, but is of opinion that as soon as the conditions are more favourable, the insects will return to their former haunts. He believes the periodic disappearance of these flies from localities where they were formerly numerous is due to climatic conditions affecting the migrations of big game, and the food supply, and also to the parasitism of other insects. Nothing is known on the latter subject, but the author has succeeded in discovering a definite correlation between the amount of the rainfall and the spread of trypanosomiasis among stock. This may be attributed perhaps to the fact that large game range further in rainy seasons. Other factors, however, besides the movements of the game may affect the seasonal variations in the infested areas. Thus, during the dry period, a district covered with deciduous forest does not afford sufficient shade to attract the tsetse-fly, though it may afford it a good shelter when the trees are in full leaf.

In the district of Wankie, a study is being made to determine the part played by abundance of food and the presence of large game in the variation of the zones infested by this stock pest.

F. S.

409. ***Benustomum trigonocephalus*, a Sheep Parasite.**

CAMERON, T. W. M., The Sheep Hookworm in Scotland. *The Scottish Journal of Agriculture*, Vol. VI, No. 2, pp. 196-199, figs. 7. Edinburgh, 1922.

Observations made at the Slateford Abattoir (Edinburgh) have shown *B. trigonocephalus*, to be one of the most common parasites of sheep in Scotland where the adult animals are infested by hookworm at all seasons of the year. The lambs are, however, free from this parasite. The author describes *B. trigonocephalus* and the symptoms caused by its presence in a sheep. The life-cycle of this hookworm is not known, but the results of Dr. HESSE's investigations would seem to show that infection takes place from swallowing the encysted larvae at the same time as grass. Before substituting any other stock for the sheep and cattle grazing on infected fields it is necessary to know whether the animals in question are also hosts of *B. trigonocephalus*. The author requests any farmers whose sheep have developed symptoms similar to those induced by this hookworm to forward him a description of the symptoms, together with the intestine of one, or two of the diseased sheep, and to state the duration of the disease and the number of head attacked. All communications to be addressed to the Department of Helminthology, School of Tropical Medicine, Endsleigh Gardens, London, N. W. 1 (England).

F. S.

410. The Effect of Change of Temperature on the Basal Metabolism of Swine.

CAPSTIK, J. W. and WOOD, T. B. (Animal Nutrition Institute, School of Agriculture, Cambridge). *The Journal of Agricultural Science*, Vol. XII, Part. 3, pp. 257-266, figs. 4. Cambridge, 1922.

It is well-known that animals consume a larger amount of food when the external temperature is low, the need of nutrition varying in inverse proportion to the temperature.

There are, however, very few exact data on this subject. The authors have carried out a series of researches with the object of estimating the basal metabolism of swine.

The term, basal metabolism, or resting metabolism, (abbreviation B. M.) is applied to the minimum exchange of materials taking place in the animal organism when the voluntary muscular system is resting and all digestive operations are suspended for the time. This basal metabolism depends upon the activity of all the cells composing the organism and upon the contractions of the myocardium and of the respiratory muscles.

The determination of basal metabolism, which has already become a matter of considerable importance in human physiology and in medical science, is now beginning to be regarded as a necessary factor in stock-breeding, since it affords the sole means of estimating metabolic activity under different conditions.

The data thus obtained are comparable, and make it possible to gauge with accuracy the effect exerted by pathological states and external conditions on the exchange of material and of energy, and thus to arrive at useful conclusions from the diagnostic, pathological therapeutic and hygienic standpoints. Unfortunately, however, the necessary determinations are difficult to carry out.

The total metabolic activity is estimated on the basis of heat production. The most accurate determinations are made by means of the calorimeter, but this entails complicated, costly apparatus that is difficult to handle, especially in the case of large animals, or human subjects, therefore the number of such plants is very few, even in the whole of the United States.

Recourse is therefore had to indirect calorimetry, a much more practicable method, which consists in the determination of the carbon eliminated in respiration and of the soluble nitrogen removed in the urine and faeces, both these waste products being estimated as sugar and protein destroyed by oxidation. The error may amount to 4 %, but it has no influence on the general results.

This process is very lengthy, but it can be simplified by only determining the amount of carbon dioxide given off in respiration. It is calculated that for every litre of carbon dioxide given off 4852 microcalories are developed (the amount being slightly less if protein and carbohydrates are burnt, and rather more if fats are burnt, but the above figure is near enough for general purposes).

The data obtained refer to the time unit (minute, hour, 24 hours).

As a rule, they also refer to the cutaneous area (m^2), for it has been found that under such conditions, metabolism increases regularly with the increase in the cutaneous area independently of the weight.

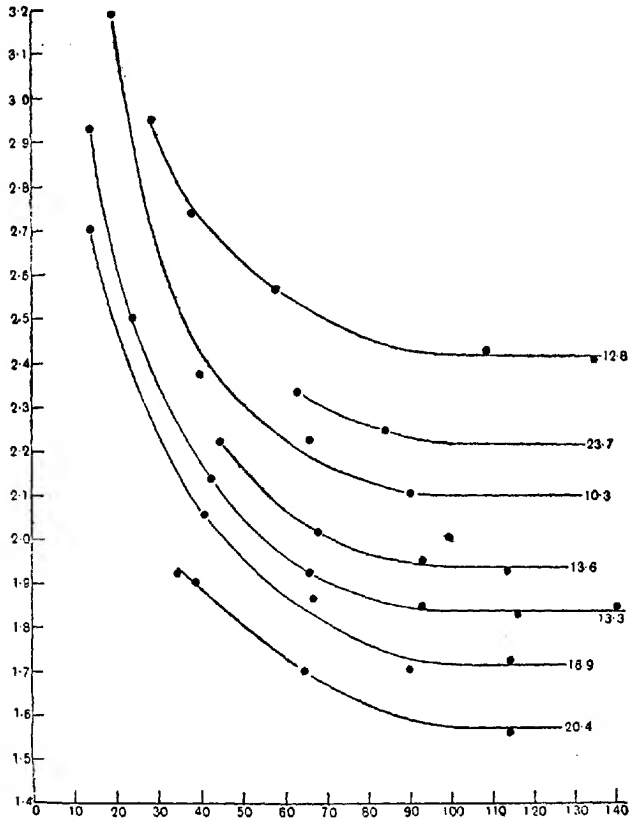


FIG. 85. — Abscissae: hours after last meal.
Ordinates: calories per minute.

There are various formulae for calculating the cutaneous area on the basis of certain linear dimensions. Other calculations of basal metabolism are simplified by the use of logarithms or better still, by the help of tables

such as are appended to BOTHBY and SANDFORD's text-book (Laboratory Manual of the Technique of Basal Metabolic Rate Determination, Philadelphia, published by Saunders).

The authors of the paper analysed employed the direct calorimetric method. They were obliged to confine their investigations to a pig, since although their apparatus was very large, it was inferior in size to the huge calorimeter adopted in the United States which allows determinations to be made upon bigger animals. The pig was 10 months old and weighed 300 lb. at the beginning of the experiment which lasted 140 days (from November to April). By means of a thermo-electric battery and a recording galvanometer the heat given off every two minutes could be registered. These are perhaps the most accurate determinations of the B. M. ever yet made.

In their preliminary experiments, the authors had already ascertained that in the case of a fasting pig, the heat given off slowly decreases

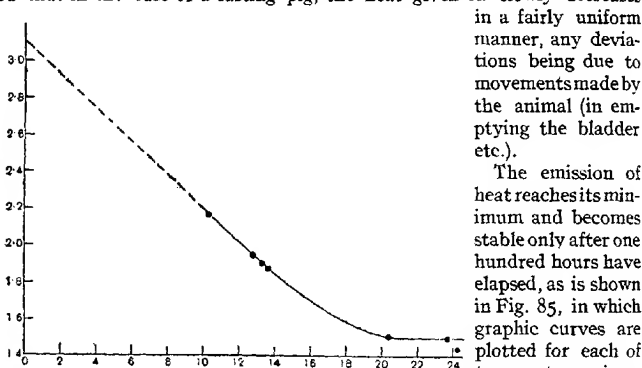


FIG. 86. — Abscissae: External temperature in degrees Celsius. Ordinates: Calories per minute.

in a fairly uniform manner, any deviations being due to movements made by the animal (in emptying the bladder etc.).

The emission of heat reaches its minimum and becomes stable only after one hundred hours have elapsed, as is shown in Fig. 85, in which graphic curves are plotted for each of the temperatures ranging from 12° to

23.7° C have however been raised to 0.3 and 0.25 calories in order to make the distribution of the curves more uniform and to show more clearly the rate of heat emission. Some of the graphic curves are incomplete owing to interruptions in the galvanometric circuit.

In T'ANG'S experiments on swine, the equilibrium was reached after only 72 hours.

After making the above-described determinations, the authors used to leave the pig in the apparatus for 4-6 days, generally for 5, before estimating the B. M. The pig which was kept in the dark and given water only, and slept many hours continuously.

The pig soon recovered when turned out-of-doors, in fact, in the course of the experiment it increased 157 lb., in spite of having fasted for one-quarter of the time.

As the animal grew older, and therefore increased in weight, it gave off a proportionally less amount of heat, so that the proportion between skin area and weight was reduced. The decrease in basal metabolism in proportion to weight was almost regular. On the basis of the data thus obtained, the authors corrected the determinations made at different times so that they all referred to the weight of 800 lb.

This having been done, it was possible to determine the effect of the external temperature which varied from 10.3° C. to 23.7° C., the extreme temperatures of the place in which the experiment had been carried out. The temperature of minimum metabolism was thus found to be 21° C., this is a critical point, the heat given off being 1.5 calories per minute.

The metabolism remains equally low at about 24° C, the highest temperature tested. On the other hand, by reducing the temperature, the metabolism can be intensified almost regularly 4 % for every of one degree centigrade until the minimum temperature tested, 10.3° C. As is shown by Fig. 86, the deviation observed at 16° C., is probably due to the restlessness of the animal during that special determination and should not be taken into account. From the regular course of the graph, it would presumably be possible to continue it in a straight line above 10.3° C., as is shown by the dotted line in this figure, hence at an external temperature of 0° C, the heat given off would exceed 3 calories per minute viz., it would be more than double the amount emitted at the critical temperature of 21° C.

Practical results : Swine should be kept at a temperature of 21°-24° C., in order to reduce consumption to the minimum and therefore to obtain the maximum utilisation of their food. The greater advantage is obtained the more nearly the temperature approaches the above figures. At 8° C., the average winter temperature of the sty, the consumption is $\frac{1}{3}$ more than at 18° C., the average summer temperature.

The greater consumption is to some extent covered by more liberal feeding, but also partly by the better use of the food given, especially of the coarser kinds which from "extra material" (reserve store).

I. V.

411. The Fat-Protein Ratio in the Feeding of Domestic Animals.

LETARD, E. (Chef des travaux de zootechnie à l'école nationale vétérinaire d'Alfort). Le rôle des graisses dans l'alimentation du bétail. Le rapport adipo-protéique. *Revue de zootechnie. La Revue des Éleveurs*, Year 2, No. 4, pp. 292-303, tables 2, 1 graph., bibliography. Paris, 1923.

The author describes fat formation in the organism and the part played by fats in the ration, and then considers the subject of the fat-protein ratio in the feeding of recently-born animals. This ratio, which has been determined by the study of milk, is as follows: 1-9.82 for lambs; 1-0.85 for calves; 1-0.9 for kids; 1-0.9 for piglings; 1-1.1 for foals; 1-1.2 for puppies; 1-1.5 for donkey foals; 1-1.5 for young rabbits.

Basing his data on the studies of CREVAT and KELLNER, the author gives the following ratios for adult animals, which cannot as yet be pre-

cisely fixed, but may vary within the following limits: work horses 1-2.6 to 1-4; suckling mare 1-4; foal (3-6 months) 1-2; foal (6 to 12 months) 1-3; foal (over 6 months) 1-4; work ox 1-2.6 to 1-4; adult fattening steer 1-4 at first, 1-2.7 to 1.3.1 later; dairy-cows 1-4 to 1-6; dual purpose cattle (2-3 months) 1-1.8 to 1-2; id. (3-6 months) 1-3.1; id. (6 to 12 months) 1-3.8; young work cattle (2 years) 1-4; young heifers (2 years) 1-6; young beef cattle (2 to 6 months) 1-1.7 to 1-2; id. (5 to 12 months) 1-3.2 to 1-3.3; id. (10 to 15 months): 1-3.5; sheep for breeding (of less than 5 months) 1-1.4; id. (5 to 20 months) 1.4-1.6; fattening sheep: 1-2.8 to 1.3-8; nursing or milk ewes: 1-4; pigs (2 to 6 months) 1-2.5 to 1-6.5; id. (6 to 9 months) 1-7.8; id. (9 to 12 months) 1-11.

In practice it is better to introduce the fat into the rations under the form of a natural food rather than as crude or heavy oils which may cause digestive disturbances such as loss of appetite, diarrhoea, etc. In the case of domestic animals, it is well to keep within the following limits: adult horse: 0.800 kg. per day and per 1000 kg. of live weight; ox: 0.700 kg. per day and 1000 kg. live weight; sheep: as much as 1 kg. per day and per 1000 kg. live weight; swine: 0.500 kg. to 0.700 kg. per day and per 1000 kg. live weight; in the form of milk they can however stand 2 kg. of fat per day and per 1000 kg. of live-weight.

The author describes how fats can be used in carrying out certain stock-breeding operations. F. S.

412. The Sugars and Albuminoids of Oat Straw.

COLLINS, S. H. and THOMAS, B. (Agricultural Department, Armstrong College, Newcastle-on-Tyne). *The Journal of Agricultural Science*, Vol. XII, Part 5, pp. 280-286. Cambridge, 1923.

Mc CALLUM has proved that although maize grain is a very incomplete stock-feed, adult cattle thrive if fed the whole maize plant, which also promotes the development of suckling calves when it is given to their dams.

This agrees with the opinion held that the whole plant of grain cereals has about the same composition as meadow hay. Many agriculturists even maintain that straw makes an excellent stock-feed. The difficulty, however, consists in obtaining straw that animals will eat readily.

The authors studied the chemical composition of straw and the factors influencing its quality. Oat straw was chosen for the experiments as this cereal is much cultivated in Great Britain, and they studied the effect exercised by climatic and meteorological factors and by the application of fertilisers.

COLLINS had already previously worked on these subjects, and was enabled to resume his investigations owing to a grant made by the Ministry of Agriculture.

The sugar content of oat straw varies within very wide limits ranging from 6.33 to 9.47 %. The percentage present is much affected by the meteorological conditions during ripening. This sugar disappears by degrees; if the straw is kept dry, its sugar content decreases slowly, otherwise the

percentage falls rapidly. The sugar in oat straw is chiefly levulose, while that of wheat is principally dextrose. In oat straw, levulose never forms less than 50 % of the whole ; the rest of the sugars are derived to a great extent from saccharose one molecule of which consists of levulose.

The protein of straw calculated according to the usual formula, $N \times 6.25$, also has a wide range of variation, extending from 1.12 to 8.05 %. This variation depends to a considerable extent upon the nitrogen content of the soil, the organic nitrogen present being the most important factor.

A useful circle is therefore established, for the nutritious straw supports a large number of stock which, in their turn, liberally manure the soil thus producing a straw rich in protein. The climate also has a great effect, for this reason in the northern districts, where the season is short, the crop is often harvested early, in order that the grain may not have time to abstract the protein from the culms, which therefore remain more nutritious. This explains why Scottish oat-straw is more suited for a cattle-feed than the straw of oats grown in England. Moisture is also an important factor. In dry seasons, the oats are cut early, before the seeds have had time to draw upon the nitrogenous reserves in the culms.

So-called, sweet straw, is in reality rich in protein, not in sugars. The food value of straw seems to depend chiefly upon its protein content

I. V.

413. The Food Value of Dried Whey Solids.

OKA, J. B. and CRICKTON (Rowett Research Institute). *The Scottish Journal of Agriculture*, Vol. VI, No. 1, pp. 63-67. Edinburgh, 1923.

The authors have tried to estimate the food value of the residues (dried solids and protein) of whey. The residues were prepared in the form of a powder, care being first taken to remove all the fat left after cheese-making, therefore these solids contain 5 times less fat than the residue of ordinary whey.

The object of the first experiment was the comparison of a mixture of dried solids and lact-albumen (protein substances in whey) with whole milk. The experiment lasted 28 days and the pigs used were 34 days old when it began. The results obtained were as follows :

Food	Gain in live-weight	Average ration consumed by each animal
Whole milk	18.7 lb.	61 lb.
Residues	17.8 lb.	Lactalbumen 1 lb. Solids . . . 8 lb.

The ration including the residues contained 8.6 lb. of solids and the other contained 7.8 lb. solids.

In the second experiment, a comparison was made between whey

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powder and whey in its natural condition when they are added to a mash composed of maize, oatmeal and shorts in equal parts.

The results obtained were as follows :

Food	Average amount consumed per animal	Average increase in live-weight
Skim milk and mash	{ Skim milk . 123.6 lb. { Mash 17.8 lb.	17 lb.
Whey powder and mash	{ Whey powder 11.7 lb. { Mash 11.7 lb.	15.4 lb.
Mash	Mash 22.5 lb.	10.8 lb.

The rations of skim-milk and of whey powder contained about the same quantity of solids, and are therefore comparable.

Other experiments have been begun to determine the value of these residues as a calf-feed. F. S.

414. A Study on the Pasteurization of Colostrum.

RAGSDALE, A. C. & BRODY, S. (Dairy Husbandry Department, University of Missouri). The Colostrum Problem and its Solution. *Journal of Dairy Science*, Vol. VI, No. 2, pp. 137-155, 1 fig., bibliography. Baltimore, 1923.

Colostrum plays a very important part in the regimen of the calf by reason of the globulin and the defensive bodies which it contains, such bodies being absent in the early days of the life of the calves. It is therefore necessary that these bodies and the globulin should be left intact when the colostrum of a tuberculous cow is to be disinfected. Disinfection can be carried out by means of pasteurization by placing the vessel containing the colostrum in a bath and warming by steam heating.

Care must, however, be taken to avoid the coagulation of the colostrum while heating for the purpose of sterilising the tubercle bacilli. The following table shows the time required at different temperatures for obtaining these two results :

Temperature Degrees F°	Time required to inactivate the organism of tuberculosis in milk	Time required to thicken colostrum so that it barely flows
	minutes	
140.0	20.0	3 hours
144.5	18.5	30-40 minutes
149.0	14.0	10-15 "
153.5	7.5	4-5 "
158.0	3.0	2 "
162.5		70-75 seconds
167.0		45-50 "

These figures have an approximate value only and vary with the composition of the colostrum, but they show that colostrum may be safely pasteurized at a temperature of 140° F.

In the experiment, calves that received pasteurized colostrum showed a mortality of 6 per cent. while for those that were fed on raw normal milk the mortality was at the rate of 32 per cent.

These figures amply justify the pasteurization of colostrum and show that the process does not materially affect the protein or the protective bodies. Laboratory experiments have also proved that by heating to a temperature of 140° F, the value of the amboceptor or protective body is not diminished.

Further experiments are to be made with regard to the effect of heat on these protective bodies.

F. S.

415. Cod-Liver Oil in the Feeding of Cattle and Swine.

I. — DRUMMOND, J. C., COWARD, K. H., GOLDING, J., MACKINTOSH, J. and ZILVA, S. S. Cod-Liver Oil in the Winter Feeding of Milch Cows. *The Journal of Agricultural Science*, Vol. VIII, Part 2, pp. 144-152, bibliography. Cambridge, 1923.

II. — DRUMMOND, J. C., ZILVA, S. S. and GOLDING, J., The Use of Cod-Liver Oil in the Feeding of Farm Animals. *Ibid.*, pp. 153-162, 1 table, bibliography, Cambridge, 1923.

The object of the experiment was to determine whether it is possible to maintain the vitamine content of cow's milk by adding to the ration of the cow small quantities of some substance that is very rich in vitamine A, such as cod-liver oil.

Three lots of grazing cows were put into the cow-shed at the beginning of December after the vitamine content of their milk fat had been analysed. From the time, they were removed from the field, the animals were given a ration containing no vitamine A, and as soon as the fat had decreased, they were divided into two lots, one of which (lot a) was fed pure cod-liver oil in quantities increasing progressively from 75 gm. to 100 gm. per day, while the other (lot b) received the same amounts of neutralised olive oil. There was a constant and very remarkable increase in the amount of the vitamine A present in the fat of lot a. The vitamin content of the fat of lot b also increased, but always remained lower than that of lot a. During the whole time the cows were kept in the shed, groups II and III received the same rations as group I, except that from February the cows of group II were allowed to graze for a short time each day, while those of group III could graze *ad lib.* throughout the whole winter. The analysis of the fat content of the milk of these animals showed that the vitamine concentration increased together with the amount of lipochromes in proportion as the grass became richer, but it was always lower than the vitamine concentration in the milk-fat of the animals belonging to the first group.

II. — The cod-liver oil used for feeding farm animals should be clear and bright, it is best when the colour is not deeper than a golden-yellow.

When added in the proportion of 3 drops to 3 cc. + 1 drop concentrated sulphuric acid, it should produce a deep purple colouration. The authors advise that it should be kept in a closed vessel to prevent oxidation by contact with the air. It should be given alone to the stock and not mixed with other substances which would make it difficult to test its quality.

In the case of pigs, from 7 to 18 gm. per day are enough to stimulate the growth and improve the general condition of the animals. In the opinion of the authors, a stronger dose (42 to 56 gm. per day) of first quality oil is very good for sows in farrow and increases both the milk secretion and the vitamins A. It was found by experiment that this oil is readily taken by pigs, especially when they have no access to a pasture and are fed a ration with low vitamin content. Although the meat and fat never acquired any taste or smell of cod-liver oil, the authors advise that its use should be discontinued for some little time before the pigs are slaughtered.

The authors also found that cows readily take 14 to 56 gm. of cod-liver oil daily, and that even if the dose were increased to 112 gm. per day, there was no smell or change of colour in the milk.

F. S.

Breeding.

416, Artificial Fertilisation in Stock Breeding. (1)

IVANOFF, E. I. (Director of the Central Experiment Service Station for Domestic Animals in Moscow, Russia). *The Journal of Agricultural Science*, Vol. XII, Part 3, pp. 244-256, bibliography. Cambridge, 1922.

One of the greatest problems in Russia is the reconstruction of the breeding stock which has been almost entirely destroyed as a result of the war, the revolution and famine.

It is not merely a question of increasing the number of head, but of improving the quality of the animals. Good breeding stock is almost entirely lacking, and whereas before the war, there was one service stallion to every 600 mares, now there is only one to every 3000. A stallion can serve, throughout the year about 10-40 mares, the average being 25-30, hence it is evident that the solution of the problem consists either in greatly increasing the number of stallions, which under the present financial conditions in Russia is impossible, or by using one stallion to fertilise a large number of mares which can be done by means of artificial fertilisation. By this method, the seminal fluid is more economically used; it is distributed in small quantities, but injected in a manner to assist fertilisation. The seminal fluid may be used just as it is ejected, in which case, the sperm-cells are suspended in the secretion of the accessory sexual glands (SPALLANZANI has demonstrated, in Italy the fertilising action of this product), or else, the seminal fluid may be diluted with some artificial solution, such as a solution of sodium chloride, Locke's solution,

(1) See *R.* 1915, No. 307.

bloodserum, etc. It was at first thought that these artificial media might injure the spermatozoa, but they were found to be unaffected.

Evidently, we here have a case of "artificial insemination" rather than of "artificial fertilisation".

The author gives some data respecting technique. The seminal fluid is collected, by means of a sterilised sponge, immediately after coition. The sponge should be sterilised by immersion for an hour in 60-65 % alcohol and then carefully washed in sterilised water, after which it should be repeatedly washed (and squeezed out every time), in a physiological solution of sodium chloride, or else in a 10 % solution of refined sugar. After it has been ascertained that the spermatozoa are active, they may be injected into the vagina by means of a syringe, or catheter.

It is most probable that, in future, the method will be improved so as to permit of the spermatozoa being kept alive long enough to be sent to a distance. At present, the investigators have succeeded in keeping them alive for a week, but only if the spermatozoa have been taken directly from the epididymus and kept at 10-20° C. When in contact with the fluid from the accessory sexual glands, the spermatozoa acquire the maximum energy, but they die in a few hours.

Artificial fertilisation is of practical importance, not only because it provides the means of fertilising a greater number of females (one stallion sufficing on an average for 300 mares at any season), but from the many other advantages it possesses. Thus, it can overcome female sterility due to mechanical causes (cervical stenosis, flexions, polyps, etc.); allows of crossing individuals differing greatly in size; permits of crosses being made between very distantly related species (zebra with horse or ass, ordinary cattle with bison, etc.), prevents any contagion being conveyed to the male from diseased females (in districts where glanders etc., are prevalent); and is a means of freeing the spermatozoa from trypanosomes (in regions infected with trypanosomosis). Further, this new method makes it possible to ascertain by microscopic investigation the maturation and mobility of the nemasperms, and hence to determine the reproductive capacity of a stallion before, instead of after, his service career has begun; allows of a homogeneous stock being rapidly formed upon which selection can operate with certainty and efficacy, it permits of the possible use of the reproductive capacity of males that are severely wounded, or have died a violent death (in which cases the contents of the seminal vesicles are collected), and renders feasible the fertilisation of wild animals in captivity (deer, foxes which are monogamous, etc.). The chief advantage of this method, however, certainly consists in the opportunity it affords of rejecting inferior males and using the best individuals to the fullest extent.

The author gives a short account of the work carried out in Russia on artificial fertilisation as applied to the breeding of stock, especially of horses. The preparatory, or experimental, stage was followed by many practical tests, and finally a special Laboratory and a Station were instituted at Askania-Nova. By these means it was possible to determine the conditions of success, one of the most important of which is the repetition of the trials. The number of fertilisations proved to be, on an average

ten times as large as under natural conditions, as many as 78 % of positive results being obtained which is more than those produced by natural fertilisation ; further, it was found that the offspring were not inferior in vigour and reproductive capacity to the young of naturally mated animals. Practical courses were then started ; these were attended by 400 persons between 1909 and 1919 ; lectures were also given so that the method became widely adopted in Russia and the first test on a large scale of the artificial fertilisation of domestic animals was thus carried out.

The results of a questionnaire sent out by the author and of enquiries he made showed that, before to the war, artificial fertilisation was practised in, at least, 30 Governments and was spreading rapidly, so that in 1912, the author was able to obtain reliable data respecting 3397 cases of artificial fertilisation from 41 Service Stations in European Russia ; the proportion of positive results was 41.4 %, but if only stallions in heat were taken into account, the percentage rose to 59. In one Station, 90.7 % successes were scored, while at Askania-Nova 100 % positive results were obtained from 2 stallions.

Unfortunately, the War and the subsequent vicissitudes disorganised this work as well as other forms of research, but an effort is now being made for its reconstruction. In 1919, at one of the Pan-Russian Stock-Breeding Conferences, inaugurated by the Live Stock Department and the People's Agricultural Commissariat, and in successive Pan-Russian Conferences for horse-breeding, the problem of artificial fertilisation was considered of immediate importance. The College of the Commissariat decided to start a Central Experiment Station for the study of the breeding of domestic animals, one of the chief objects of this Station being the practical organisation of artificial fertilisation. In 1921, many requests reached the Station, but unfortunately nothing could be done owing to the complete lack of material and workers, but in 1923, a number of experts were to take diplomas and proceed to institute Service Stations provided with the means of artificial fertilisation, in various parts of Russia.

The work of artificial fertilisation has often been entrusted to persons, who not being experts, made serious mistakes, such as injecting semina into already fertilised mares (which produced abortion), or using sterile stallions, or stallions not in heat, etc. Sometimes again, the task was imposed upon veterinaries, who receiveing no pay for their work, carried it out once a week as a kind of forced labour, taking no responsibility as to results.

The author urges the use of capital for this work of reconstruction, and points out the commercial advantages to be derived from it, giving as an instance the following calculation made in gold roubles : equipment of Station for artificial fertilisation 200 ; two stallions 1000 ; maintenance expenses for four months 200 ; wages 200 ; stabling 100, total 1700 ; returns from artificial fertilisation of mares at 5 roubles each, 3000 ; profit : 1300 (representing 76 % on the capital outlay).

L. V.

417. **Genetics in Fur Farming.**

MCARTHUR, J. W. O. *A. C. Review*, Vol. XXXV, No. 7, pp. 267-268 and p. 10. Guelph (Canada), 1923.

On crossing a pure silver fox with a red fox, hybrids of intermediate colour ("patch") are obtained in the F_1 , while the F_2 consists of $\frac{1}{4}$ pure red, $\frac{3}{4}$ patch and $\frac{1}{4}$ pure silver individuals. The pure silver animals when mated together, produce pure silver offspring, and if crossed with patch individuals, they produce 50 % patch animals and 50 % pure silver hybrids. The silver character is, however, composed of several variants all of which make their appearance pure, without any admixture. Pale silver is partially recessive to dark silver.

A series of colour mutations have been observed in the skunk viz., black, seal brown, striped, almost pure white and pure albino. These colours are transmissible and can be obtained pure, if care is taken to avoid too close-inbreeding. In the skunk, as in the fox, the hybrids of these mutations transmit their characters according to the law of segregation. As a rule, colour is dominant to albinism, and whole black to white stripes, but in the F_2 , the parental types may appear either pure, or in the form of some new combination.

F. D.

*Special.*418. **Stock Raising and Beef Production in the Philippines.**

BUENCAMINO, V. Our Meat Supply, *The Philippine Agricultural Review*, Vol. XV, No. 3, pp. 237-240. Manila, 1922.

The author uses the special experience gained in the city of Manila and the neighbouring provinces as the basis of information which may be a useful guide to traders in live-stock in the Philippines and describes at the same time the different breeds that are raised and their characteristics.

The Manila market is supplied with native cattle from Batangas, Dalupiri, Fuga and the islands to the south of Luzon and with foreign cattle coming from China (Hong-Kong, Tsingtao), from Cambodia (Pnom Penh), from Annam (Qui-Nhon), from Australia (Wyndham).

The most profitable breed of native cattle, which resembles very closely that imported from China, is the Batangas. This is the only Philippine breed which is docile and can also be used for work. It arrives in good condition being usually at least 5 years old and averages about 126 kg. dressed weight.

The Dalupiri cattle are descendants from a Spanish breed but during the last 10 years, Indian blood has been introduced. The average weight is about 90 kg. and the flesh has a dark tinge. It is a wild race and generally killed at the age of 3 years without previous fattening; the same may be said also of all the other Philippine breeds with the exception of the Batangas.

Fuga cattle are very small averaging at most 60 kg. dressed weight. The stock seems to be degenerate and to have insufficient pasture.

As regards the islands to the south of Luzon, Masbate stands first both for number and quality which is probably due to its fine pasturage. The type is beginning to show evident traces of the infusion of Indian blood. The average weight is 80 kg. and there is a little yellow fat.

Mindoro and Marinduque cattle have an average weight of about 66 kg.; they are fat but somewhat less wild than the Dalupiri.

The Mindanao type is distinctly Indian and it appears that this island is likely in the near future to become an important centre of beef supply.

Selection, castration, improvement of pasturage and fattening would bring about a great improvement in beef production in the Philippines.

At the present time, the best beef cattle are imported and their dressed weight averages 150 kg. at the age of 6 years. They are very fat, docile and good workers, with the exception of those imported from Australia.

Hongkong cattle are short-legged, bulky, fleshy and small-boned; their dressed weight is from 45-55 per cent. The hide is thick and suitable for boot-soleing.

The Tsingtao cattle are still larger and are about the same size as the Australian, with an average of 200 kg. dressed weight or over.

The Pnom Penh cattle are large-boned, very hardy, thrive well on rice straw and are resistant to the risks of transport. They are in special favour for the manufacture of anti-rinderpest serum and are good workers.

Annam supplies a limited number of small docile animals, with an average dressed weight of about 100 kg.

The cattle imported from Australia are large and fat with an average dressed weight of from 260-270 kg. and a maximum of 300 kg. They give 50-60 per cent of beef and are readily accepted on the market but transport is difficult and risky as they are very wild and non-resistant to disease.

F. D.

419 The Necessity for Calcium and Phosphorus in the Diet of Dairy Cows.

122 MEIGS, E. B. (Dairy Division, United States Department of Agriculture). The Mineral Requirements of Dairy Cows, Present Status of the Question. *Journal of Dairy Science*, Vol. VI, No. 1, pp. 46-53. Bibliography, Baltimore, 1923.

The author after reference to the work of FORBES and HART, sums up the evidence so far presented by stating that it appears that liberally milking cows are usually able to maintain themselves in calcium and phosphorus equilibrium (1), when they receive an abundance of good lucerne hay, combined with concentrated foods, rich in phosphorus.

(1) See R. 1922, No. 842. (N. d. R.)

The Ministry of Agriculture of the U. S. A. is at present making an experimental test to establish the value of coarse foods with a low calcium content which are fed instead of lucerne. To one group of cows is given a mixture of grains high in protein and timothy hay only, or timothy hay and silaged maize; another group received the same rations with calcium carbonate added, or a ration containing the same or approximately the same protein content but with lucerne hay, instead of timothy. These experiments have not yet been completed, but the results obtained, show that sooner or later the yield of milk from cows who receive forage with a low calcium content, is greatly diminished and that this decrease is mostly due to the calcium deficiency.

On the other hand it appears that the liberally milking stall-fed cows can be kept in calcium equilibrium only if fed on large quantities of forage with a high calcium content as for example, lucerne hay.

Since the experiments of FINGERLING and HART, many others have been made, and seem to indicate that the assimilation of calcium and phosphorus is influenced by vitamins. Dairy cows on pasture can maintain calcium equilibrium on a smaller absolute calcium intake than those on dried materials with or without maize silage.

FORBES reported that in the case of cows that were dry or giving only small amounts of milk, the calcium and phosphorus balances were both usually positive. The cows used in these experiments, however received lucerne hay.

Some tests were made by the Ministry of Agriculture of the U. S. A. to determine what influence the substitution of timothy hay for lucerne had on cows giving small amounts of milk. Cows on timothy hay have continued to give a small amount of milk for many months consecutively, but these cows were being fed on rations which contained much more protein and nutritive matter than they required according to any of the feeding standards.

It is likely therefore, that the results indicated only confirm the theory that cows giving small amounts of milk can eat much more food than they require, and compensate in that way for the absence of a particular substance in the rations given to them.

It is perhaps not too strong a statement that it is always bad practice not to include liberal quantities of leguminous hay in the rations of dairy cows which are receiving only dry feeds and silage.

The dairy farmer must not expect to obtain a large yield of milk in winter if he cannot give his cows lucerne and other leguminous hay in large quantities. It will probably pay him also to see that each of his cows has a dry period of two months and that during this period she receives twice the maintenance ration in protein and total nutrients.

The author also states that so far experimental work has not been sufficiently advanced to demonstrate whether lucerne hay can be replaced by other leguminous hays to provide a source of calcium, or how the calcium requirements of cows on different kinds of pastures can be supplied.

F. S.

420. A Study of the Influence of the Genetic Factor and Environment on Milk Yield.

SANDERS, H. G. (School of Agriculture, Cambridge). The shape of the lactation curve. *The Journal of Agricultural Science*, Vol. XIII, Second Part, pp. 169-179, tables 7, figs. 2, bibliography. Cambridge, 1923.

Taking as a basis the figures supplied by the Penrith (Cumberland and Westmorland) Milk Recording Society, the author has constructed what he calls a "Shape-figure" for each lactation period and from an examination of such variations in this figure as are due to the chief factors affecting milk yield, he has arrived at certain conclusions regarding the influence of environment and of the genetic factor.

The "Shape figure" (S. F.) is obtained by dividing the ratio existing between the total yield of the lactation period and the daily maximum production during the period, by the average ratio between the two values for cows calving during the same month as the cow whose lactation period is under observation. These average ratios for the different calving months are as follows: January: 178.6; February: 166.2; March: 165.4; April: 154.0; May: 142.9; June: 145.1; July: 151.6; August: 185.6; September: 183.4; October: 190.5; November: 198.0; December: 183.7. The S. F. thus serves to correct the calving month. On the basis of 100 days' interval between calving and the next fertilisation, the author obtained the following corrections to be made in the S. F. for different intervals between these dates: 0-19 days + 22%; 20-39 days + 16%; 40-59 days + 9%; 60-79 days + 5%; 80-99 days + 1%; 100-119 days - 3%; 120-139 days - 7%; 140-159 days - 10%; 160-179 days - 13%; 180-199 days - 15%; 200-219 days - 17%; 220-239 days - 20%; 240-259 days - 22%; 260-279 days - 24%; 280-299 days - 26%; 300-319 days - 27%; 320-339 days - 28%; 340-359 days - 29%; 360-379 days - 30%; 380-399 days - 31%; 400-419 days - 32%; 420-439 days - 33%; 440-459 days - 34%; 460-479 days - 35%; 480-499 days: 35%.

On examining the effect of age on the S. F., the author found that, in the case of the first lactation, this figure was generally 11% higher than in that of the second lactation. It varies little between the second and the fifth lactation, and the reduced yield after maturity is not due to any physiological deterioration of the glands, but to feeding and other factors. The author has not been able to reach any definite conclusion as regards the rest period preceding lactation.

In order to determine whether the milk yield of a cow depends solely upon the environment or also upon hereditary capacity, the author compared the standard deviation of all the 355 S. F. of a group of 100 cows with that of the S. F. of each of these animals and found that the latter deviation was less. On the other hand, the standard deviation of the average S. F. of any group of 3 lactation periods taken from the 180 lactation periods of the 60 cows under consideration when compared with the standard deviation of the average S. F. during the 3 lactations of these 60 cows shows that the latter deviation is the greater. These compari-

sous were made with uncorrected S. F. which were subsequently corrected for the effect of calving and the following fertilisation. They show that the S. F.'s of different cows have a tendency to group themselves around a type which would seem to indicate a genetic influence for each cow. Further, on comparing the S. F.s of good milkers with those of cows of inferior yield, the author found that the first, the ratio between the maximum daily yield and the total production was higher for the second class, this difference being very marked in cows of the same herd.

The variations in the ratio between the total yield and the maximum daily yield of the same animal, leaving out of account variations due to accidental circumstances, throw some doubt upon the value of the maximum daily yield as a basis for determining the hereditary capacity of a cow.

F. S.

421. Influence on Cows' Milk Secretion due to the Change from Dry to Green Diet.

GOLDONI, E. Modificazione della secrezione latteia nel momento di transizione del regime secco al verde. *La Nuova Veterinaria*, Year I, No. 3, pp. 8-9, No. 4, pp. 101-105, table I, Bologna, 1923.

The author has made an experimental study of the alterations in milk secretion and on the composition of milk in cows when sent to pasture after being fed on hay. The conclusions are as follows: grass feeding appears to favour an increased yield, especially at the evening milking, but it does not seem to affect the yield in proportion to the age of the cow, or the condition of the secretion. When on grass diet, the evening milking tends to be more abundant than the morning milking; the acidity of the milk of cows whose lactation period is already advanced increases whereas it diminishes with other cows and the point of congelation is slightly lowered; moreover, the density of the whey may diminish and its congelation point decrease. Grass feeding has no effect on the content in fatty matter and the examination of the average yields of all the cows shewed that for both dry, and grass diet, the degree of acidity, the amount of dry and non-fatty residue, the density and the percentage of water were the same, although during the change of diet, the density had slightly increased for the morning milk and slightly decreased for the evening milk. On the whole, the variations between the figures for these different points, were less marked for a grass than for a dry diet.

F. S.

422. Study of the Variation in the Milk Yield of Guernsey Cows.

GOWEN, J. W. (Maine Experiment Station). Studies in Milk Secretion. Relation Between the Milk Yield of One Lactation and the Milk Yield of a Subsequent Lactation in Guernsey Advanced Registry Cattle. *Journal of Dairy Science*, Vol. VI, No. 2, pp. 102-121, tables 21, bibliography. Baltimore, 1923.

From the data supplied by 1476 lactation periods of Guernsey cows belonging to the American Guernsey Cattle Club Advanced Register,

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the average differences between the milk yield of cows of a given age that had been previously tested for milk production, and the yield of other cows of the same age of which the milk production had not been controlled previously, were as follows: 590 kg. for cows of 3 and 6 years of age, 545 kg. for those 4 years old, 680 kg. for cows of 5 years of age and 900 kg. for those of 7-8 and 9 years of age. These differences would seem to be due mainly to external factors (maintenance, feeding, preparation) which can cause a variation of $\frac{1}{6}$ to $\frac{1}{8}$ in the milk yield.

On the other hand, a somewhat close connection exists between the milk yield of one lactation period and that of another; this correlation may be expressed by the coefficient 0.696 in the case of Guernsey cows.

Table I gives the equations for calculating (upon the basis of the milk production at a given age) the milk yield of the same Guernsey cow at another age. In this table, Y represents the required yield at the age expressed in the form of the coefficient and y the yield at the age (also expressed by the coefficient) on which the calculation is based. These figures refer to lb.

$Y^3 = 1803 + 1.003 y^2$	$Y^{7,8,9} = 6016 + 0.677 y^3$
$Y^4 = 3686 + 0.842 y^2$	$Y^5 = 1099 + 1.075 y^4$
$Y^5 = 4458 + 0.940 y^2$	$Y^6 = 3685 + 0.801 y^4$
$Y^6 = 3347 + 0.984 y^2$	$Y^{7,8,9} = 2613 + 1.055 y^4$
$Y^{7,8,9} = 5669 + 0.779 y^2$	$Y^6 = 570 + 1.062 y^5$
$Y^4 = 2713 + 0.895 y^3$	$Y^{7,8,9} = 4742 + 0.728 y^5$
$Y^5 = 5610 + 0.658 y^3$	$Y^{7,8,9} = 1172 + 1.069 y^0$
$Y^6 = 4190 + 0.837 y^3$	$Y^{7,8,9} = 3492 + 0.829 y^7$

F S.

423. The Variation in Milk Yield and in Transmission of Milk Characters in Jersey and Red Danish Cattle.

TAGE, ELLINGER (Bussey Institution, Harvard University). The Variation and Inheritance of Milk Characters. *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 9, No. 4, pp. 111-116, tables 7. Easton, 1923.

The correlation between the lactation period and the rest period is 0 for the Danish breed and 0.25 for Jerseys. The duration of lactation is not affected by the maximum yield of milk during that period and is influenced very little by the rapidity of the fall in the milk production, but on the other hand, 80 to 90 % of the variation in yield is due on an average to the calving time.

After comparing the variation coefficients of the first 4 periods of 10 weeks of the first lactation period, the author reached the conclusion that under existing conditions, the yield during the first 10 weeks of lactation gives the best basis for estimating the milk production of a cow.

In the Red Danish breed, there is no correlation between the amount of milk given and the fat content of the milk, whereas in Jersey, the coefficient is 0.33.

In the case of the Red Danish cows, 75 % of the variations in the total fat yield are due to variations in the amount of milk produced, and only 25 % to differences in the fat content. From this standpoint, the influence of the season is very considerable; a difference of 15 % having been observed between the yield of cows calving in October-December as compared with that of cows not calving till January-March.

The author is of opinion that milk characters are transmitted in the same manner as "blended" characters (1). He was unable to find any factor that followed the Mendelian laws. F. S.

424. Milk as the Sole Ration for Calves.

MC. CANDLISH, A. C. (Dairy Husbandry Section, Town State College of Agriculture and Mechanic Arts). Studies in the Growth and Nutrition of Dairy Calves. *Journal of Dairy Science*, Vol. VI, No. 1, pp. 54-66, tables 9, bibliography. Baltimore, 1923.

The author first summarises the work previously done on the subject, and then describes his experiment and the conclusions he reached from the study of the results obtained. Two calves were used in the experiment, which throughout their lives (208 and 176 days respectively), were given only milk and licking-salt. The amount of milk and salt consumed, the weight and body measurements (which were taken every 30 days), as well as the increase in weight and height as compared with that of a normally-fed calf are given in the tables. Other facts are also noted including the results of the post-mortem examination of the two animals.

*Comparison between the food substances required by calves
and the food substances supplied.*

Age	Average live weight	Amount of milk received	Food substances given			Food substances required		
			Dry matter	Digestible		Dry matter	Digestible	
				Crude protein	Total		Crude protein	Total
Days	Kg.	Kg.	Kg.	Kg.	Kg.	Kg.	Kg.	Kg.
1-30 . . .	76	260	35	8.55	47	52	8.58	49
31-60 . . .	96	300	41	9.90	54	67	9.45	50
61-90 . . .	122	379	52	12.60	68	88	13.50	67
91-120 . . .	139	405	55	13.50	72	100	12.15	76
121-150 . .	143	393	54	13.05	75	103	12.60	78

From these data, the author concludes that although milk as a sole ration gives good results during the first three months of the calf's life, it is not sufficient for the animal at a more advanced age. On comparing the food elements given to the calves used in the experiment with those

(1) By "blended" factors are understood those producing in the F_2 type different from that of either parent and appearing in the F_1 as if they were homozygous. (Ed.)

which ought to have been supplied to them, it is seen according to the figures of WOLFF-LEHMANN (see appended table), that too little dry matter was given from the beginning of the feeding-experiment, the deficit being 33 % for the first 30 days, and rising to 66 % by the 150th day. The amount of digestible, crude protein and of nutritive substances was sufficient during the first 30 days, after which it was deficient though not in the same degree as the dry matter.

The lack of sufficient dry matter and the absence of roughage did not allow the digestive system to develop normally so as to be able to deal with all the digestible nutritive matter ingested by the animal, so that a certain amount which had not been acted upon by the digestive juices remained in the alimentary canal and decomposed there.

On reaching the weight of 67 kg., the two calves sometimes consumed as much salt as an animal weighing 450 kg., and as a rule, they ate 6 times more than a calf of the same weight fed in the normal manner. This may have been one of the causes of the digestive disturbances noted in the calves used in the experiment.

Possibly there were not sufficient antineuretic and antiscorbutic vitamins present and this may have been the reason of the unsatisfactory condition and the death of the calves.

- F. S.

425. The Water Buffalo for Dairy Purposes.

LEVINE, C. O. (Professor of Animal Husbandry). *The Lingnaam Agricultural Review*, Vol. I, No. 1, pp. 1-30, figs. 6, tables 29, graphic curves 2, bibliography. Canton, 1922.

The author describes the water-buffalo of S. China (*Bubalus bubalis* Lyd.) and gives an account of its origin and distribution, together with the results of observations made at the Canton Christian College in order to ascertain its value for dairy purposes. The observations were made during the last 4 ½ years, and the data on which the author depends refer only to lactation periods during the whole of which the milk production was tested. The fat analysis were made twice a month, the morning and evening milk being examined separately, and the milk yield was controlled twice a month at first, and during the last 3 years, at every milking.

For the greater part of the observation period the cow-buffaloes were given for each kg. of milk produced daily 4 kg. of a mixture consisting of 7 parts rice bran, 4 parts wheat bran, 3 parts rice sweepings and 2 parts crushed groundnut-cake. In addition, each of them received daily about 40 gm. of salt, enough water to make their ration into a stiff paste, and 27 to 45 kg. of a mixture of finely chopped grass. The average weight of the female buffaloes was 485 kg. and their average milk and butter production per lactation period was 870 kg. and 96 kg. respectively. The mean fat content was 11.05 %. The following are the averages of various analyses of samples of morning and evening milkings: fat 12.46 %, mineral substances 0.89 %, protein 6.03 %, sugars 3.74 %, water 76.89 %. At first, just after calving, the milk yield varies from 2.25 kg. to 6.75 kg. but this quantity gradually decreases during the lactation period which

lasts from 8 to 11 months. In most cases, the fat content continues to increase; it begins the first month at 8 to 10 % and reaches 15 or 17 % by the last month. The milk and butter are both pure white. The butter has an excellent flavour and is preferred both by Europeans and natives to cows milk butter.

Since these experiments were conducted with ordinary unimproved buffaloes of the dairy and work-type, and the common buffalo now produces 4.50 kg. of milk daily for several months and its annual output is at least 1125 kg. of milk and 67-146 kg. of butter, the author is of opinion that animals of high yield could be obtained in a few generations by means of skilful selection and careful breeding. The present type of buffalo is very resistant to piroplasmosis and tuberculosis. The disease to which it appears most subject is rinderpest, but fortunately the Bureau of Agriculture of the Philippine Islands has discovered a vaccin that immunises the buffalo for at least two years. The author mentions that the average weight at birth of 10 bull-calves and of 8 cow-calves was 31 and 30 kg., the average gestation periods being 347 days and 338 days respectively.

F. S.

426. The Use of Graphic Charts in Calculating Sheep Rations by the Method of Forage Equivalents.

LEROY, A. M. (Chef de travaux à l'Institut National Agronomique). Alimentation du Bétail par la méthode des équivalents fourragers. Emploi d'un procédé graphique pour le calcul du rationnement des moutons pendant leur période de croissance. *Revue de Zootechnie, La Revue des Éleveurs*, Year II, No. 2, pp. 103-116, graphic charts 4, figs. 3, bibliography. Paris, 1923.

The author considers that a sheep's ration is composed of a maintenance ration strictly proportionate to the animal's live-weight, and the production ration which is in relation with the daily increase in live-weight, or with the amount of the milk yield.

In one graphic chart, he gives the variations in the number of food units that the maintenance ration should contain in function of the live-weight. By means of another graph, he expresses the variation in the production ration in order to obtain a determined increase in live-weight, in function of the age of the animal, and at the same time, the law of variations in sheep at the expense of growth, or fattening. By reducing these graphic curves to straight lines, the author has succeeded in combining them in a single graph (here reproduced), which allows him to determine directly the forage value of the daily ration to be fed a lamb of given weight and increasing its live-weight daily by 100-250 gm. (See Fig. 87.)

The data used for the construction of these diagrams were obtained from experiments conducted by the author at the National Stock-Breeding Centre (*Centre National Zootechnique*) of Vaulx-de-Cernay, near Paris.

The author gives several instances illustrating the use of these graphic charts.

Value of total ration of sheep, expressed in forage units determined in function of the live-weight and daily increase in weight.

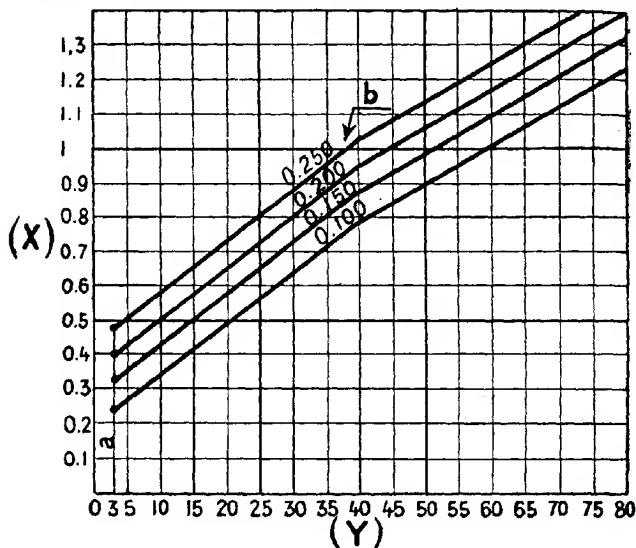


FIG. 87. — Estimation of the ration expressed in units of forage as a function of the weight age daily increase.

x Total maintenance ration as forage units.

y Live weight in kilos.

a Weight at birth.

b Daily increase in live weight, per head.

F. S.

427. The Selection of Rams for Studs and Flocks in South Africa.

VAN HEERDEN, W. S. (Sheep and Wool Expert, Division of Sheep and Wool). *Journal of the Department of Agriculture*, Vol. VI, No. 2, pp. 151-152, figs. 6. Pretoria, 1923.

The author describes the conformation of a good ram, draws attention to the importance of its having no wool on the face, and considers the choice of type and breed.

In the first place, the animal must have a good constitution and if the choice lies between good constitution and fine wool it is better to choose the first and begin with inferior wool. The ram must be of pure-bred, recognised stock and should belong to a line of which the prepotency was

first obtained by inbreeding and then fixed by breeding from lines carefully selected within the same families. Such animals will be far more likely to sire offspring similar to themselves than those which are the result of a cross between two breeds. The author classifies the sheep of South Africa as follows :

Breeds	Merino types	Merino sub-types	Merino lines
Merinoes	Rambouillet	Bundemar Wangarella Crossdale Fecurplaats Hillmoor Highland Home Bellevue Winton	Sir Charles Magician Bumper Marmion Donald Dinnic
	Tasmanian		
	Vermont		
English Long wool breed	Lincoln	These types are of little importance in South Africa.	
English Short wool breed	Suffolk		

In his opinion, crossing the different breeds offers no advantage as regards wool production and crossing the various types is open to much objection, for rams obtained by a cross between different types do not possess as much prepotency as those belonging to a line that has been inbred for many years. Farmers should therefore try to procure rams belonging to a pure type, or sub-type. The author advises that no animal resulting from a cross between a type and a subtype should be used for the production of stud stock until the new type has become fixed and its dominance secured by in-breeding. On the other hand, there is no object in crossing two subtypes together, since each of them can produce offspring of good quality and the use of an animal descended from two parents of selected stock which are not exactly alike, as they belong to two different subtypes, introduces a certain amount of irregularity into the breeding-stock.

In the case of Merino wool, all extremes are bad, but if there is to be a leaning to one side or the other, length should be preferred to density. A good long combing-wool is always appreciated, and the constitution of the sheep suffers less in the production of a long wool than in growing dense heavy wool.

The ideal wool is moderately thick and of a good length, and possessing all the qualities required for combing. In order to obtain it, the sheep-breeder must take the climatic conditions into account, for these may modify the length of the product. In bad seasons, very fine, or moderately fine wools should be short, and leave much waste, whereas a strong wool will grow to a fair length. On the Grassveld, and especially in the coldest parts, the wool, quite independently of the season, usually becomes finer and shorter as the sheep grow older.

It is also necessary to see how much yolk the ram's wool contains. If the animal is to live in a dry, hot climate, its wool must contain a con-

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siderable amount of white, fluid, clean yolk ; it is better that there should be too much rather than too little yolk, especially if the animal's food is poor and wanting in succulence. On the other hand, a ram reared in a hot climate will secrete more yolk when it is taken to a colder region, therefore all that is necessary is that the ram produces sufficient yolk to keep its wool healthy and unmatted. A ram should never be purchased with thick, pasty, yellowish yolk, as this is very difficult to remove by washing.

F. S.

428. Comparative Value of Corriedale and Dorset Horn Rams for the Production of Fat Lambs.

HINTON, F. B. (Sheep and Wool Expert). Lamb-Raising Trials, Corriedale versus Dorset Horn. *The Agricultural Gazette of New South Wales*, Vol. XXXIV, Part. 3, pp. 171-174. Sydney, 1923.

Two lots of Border Leicester \times Merino ewes (first cross) were mated respectively with 10 Corriedale rams and 10 Dorset Horn rams. The number of lambs dropped was 396 for the first lot (18 being twins) and 407 for the second (21 twins). The increase in live-weight of the two lots of lambs at the ages given was respectively: 2-3 months, 11.6 and 13.7 lbs.; 3-4 months: 12.2 and 13.5 lbs.; average at 5 months, 74.2 and 82.4 lbs. When five months old, they were respectively sold at the average price of 17s. 7 $\frac{1}{3}$ d. and £1.0s.1 $\frac{1}{2}$ d., or a difference of 2s 6 $\frac{1}{2}$ d. per lamb in favour of the Dorset Horn lot. The financial returns per ewe were respectively 15s. 2d. for the Corriedales and 17s. 9 $\frac{3}{4}$ d. for the Dorset Horns. The lambs in this lot matured earlier than the others but as regards lambing losses there was little to choose between the two groups.

F. S.

429. The Influence of Feeds and Feeding on the Type of Market Hog.

ROTHWELL, G. B. (Dominion Animal Husbandman). *The Agricultural Gazette of Canada*, Vol. X, No. 2, pp. 110-115, figs. 4, Ottawa, 1923.

The authors experiments carried out on the Central Experimental Farm, Ottawa, with a view to determining the effect of feeds and feeding on the condition of fattening-hogs yielded the following results. The young pigs given a ration of skim milk with the minimum of crude fibre developed well, and their growth was little, if at all, arrested at the time of weaning, whereas another lot fed the same ration, but without the skim milk, fattened more slowly. The animals that received a mixture of meals, meat meal and milk required a little more food than those given no meat meal, but turned out fine, large, fat pigs superior to those fed on meals alone. The pigs given meals, and meat-meal but no milk, did not develop properly ; they were deficient in length and other qualities and too big.

Two lots of pigs of the same breed and type as those used in the above experiment were fed on maize, oats, sharps, and meat-meal, but one lot was given these rations unmixed and distributed by means of an automatic feeder, while the rations of the other lot were mixed and given in limited

amounts. It was found that the first lot preferred a ration containing about 80 % maize, and fattened quicker than the second lot, which consumed less grain per lb. increase in live-weight and was classed in the select category. The other lot of animals was a little fatter and taller, especially at the shoulder. These experiments all show that any system of feeding that tends to cause too early a formation of fat in hogs fattened for bacon, and hinders maximum bone and muscle development during the first 4 months, has the effect of producing fat, short-bodied animals lacking in uniformity.

The observations of many years have also proved that it pays better to fatten hogs in cheaply constructed enclosures, rather than in closed piggeries, in which they do not grow, such a good shape. F. S.

430. **The Value of a First Cross in the Production of Pork and Bacon.**

The Journal of the Ministry of Agriculture, Vol. XXIX, No. 10, pp. 939-941. London, 1923.

During the winter of 1921, an experiment was carried out at the Lord Landsworth Institute at Long Sutton (Hampshire, England) for the purpose of determining the value of a first cross between the Berkshire and Large Black breeds of pig from the point of view of lard and bacon production. The experiment lasted 113 days; during this period the 9 Large Black pigs increased 471 kg. in weight and consumed about 1576 kg. of mixed rations, while the 9 first cross Large Black \times Berkshire hybrids gained 553 kg. in weight and ate about 1732 kg. of mixed rations. The rations varied according to the different periods, and were not quite the same for the two lots. The composition of the rations is given in the paper. The experiment shows therefore that the first generation hybrids matured earlier than the pure-bred animals, and required only 3.1 kg. of food for each kg. of increase in live-weight, whereas the pure-bred swine consumed 3.3 kg. of rations per kg. of added live-weight. F. S.

Bee-Keeping.

431. **Foul Brood.**

Ministry of Agriculture and Fisheries, Leaflet, No. 32, 6 pp., figs. 2. London, 1923.

There are three varieties of foul brood : the virulent form with strong smell due to *Bacillus alvei*, the odourless type caused by *B. Burri*, *B. Brandenburgensis* and *B. Larvae*, and the foul brood of which the pathogenetic agents are *B. Guntheri* and *Streptococcus apis*. The latter often accompanies virulent foul brood and does not form spores. The bacilli can be seen at the beginning of the disease, but when it has reached an advanced stage, they form spores and disappear. The spores are resistant to freezing, carbolic acid, thymol, salicylic acid, naphthol β , perchloride of mercury, creoline, lysol, oil of eucalyptus and naphthaline. The last 4 substances, which become volatile at the ordinary temperature of the beehive, hinder

the growth of the bacilli, but have no effect upon the spores which can be placed for two months in a solution containing 5 % of carbolic acid, or immersed for 15 minutes in boiling water without any injury. The disease must therefore be controlled during its early stages. For the prevention and cure of foul brood, the author recommends the following measures:

1) When the bee-keeper has been in contact with an infected colony, he should wash his hands and disinfect his implements with carbolic soap, or with a solution of carbolic acid (Calvert's No. 5) mixed with 12 times its weight of water. Before washing his hands or implements, he ought to remove by means of a little alcohol (pure, or denaturated), all the infected matter that is insoluble in water.

2) If a weak colony is infected, it is best to destroy the bees, combs, frames and covers, and to disinfect the hive. The bees can be killed by pouring a saturated solution of potassium cyanide into the brood-nest, care being taken to previously close any apertures by which the gas can escape. Another method is to suffocate the bees by passing sulphur fumes into the brood-nest. The dead bees, together with the combs and covers ought to be buried to avoid infection. The operation is best carried out at night when the bees stop flying. It is necessary to disinfect the hive also, this may be done by flaming the inside with a soldering-lamp or covering the internal walls with paraffin or petrol and setting fire to these substances.

3) If the disease breaks out in a strong colony, the bees can be saved by making them swarm artificially into a box or basket, and shutting down the lid. Care must be taken to insure their having sufficient air. The colony is then put in a cool place for 48 hours and fed; after this interval, the bees are put into a hive with movable frames and treated like a swarm being given syrup mixed with Naphthol β and kept moderately warm. Any of the insects that die during the treatment should at once be burnt.

When the disease occurs in a light form, fumigation or disinfection is sufficient; this may be effected by suspending from the division-wall a sponge or piece of flannel soaked once every 6 days in 40 gm. of formalin, 2 balls of naphthaline being left during this time in the brood-nest.

F. S.

432. Control of Isle of Wight Diseases in Hive Bees (1).

ANDERSON, J. (North of Scotland College of Agriculture). *The Scottish Journal of Agriculture*, Vol. VI, No. 2, pp. 183-191, bibliography. Edinburgh, 1923.

Description of the spread of the Isle of Wight disease of bees in England, and to the suggested means of control. The author states that in recent years, however, the damage has been less virulent in Great Britain, and that the number of resistant hives is on the increase. This is considered to be due to natural selection of resistant bees and points to the advisability of

(1) See R. 1922 No. 463 (Ed.)

replacement of queen bees susceptible to attack by others coming from hives free from attack. The queen should be introduced into the hive at the beginning of the season to ensure a good brood during the winter.

F. S.

433. **Larvae of the *Meloe cavensis*, Injurious to Bees in Cyrenaica.**

ZANON, V. *L'Agricoltura coloniale*, Year XVI, No. 10, pp. 345-354. Florence, 1922.

Description of the Coleopteron *Meloe cavensis*. The larvae hidden in the flowers, attack the bees and cause their subsequent death. The injured bee returns to the hive and the deleterious effect on the swarm is evident. Naphthalene sprinkled on the floor of the hive only acts as a palliative.

The only means of prevention appears to be in the case of large swarms where the workers hinder the entrance into the hive of enemies or chase them out as quickly as possible.

F. D.

434. ***Caltha Palustris*, the Cause of May Disease.**

GREMAND B. *Maikrankheit und Dotterblume. Schweizerische Bienenzeitung*, Year XLVI, No. 2, pp. 88-89. Aarau, 1923.

The author, a bee-keeper at Bettlach (Solothurn, Switzerland), noticed that May disease made its appearance among his bees, and in his neighbours' apiaries, in years when *Caltha palustris*, the marsh marigold, flowered before the cherry-trees. He therefore carried out the following experiment in the spring of 1921, in which season the above-named conditions were found. All the swarms except two were kept in the apiary until the cherry-trees were in blossom; the two swarms that were at liberty contracted the disease, as did all the bees of the neighbouring owners, but the swarms shut up in the apiary remained immune. The bees attacked, or killed, by the May disease, together with some flowers of *C. palustris*, were forwarded for examination to the Bacteriological Institute of Liebefeld (Berne). It was found that the bees had not been infested by any parasite, but that their intestines contained a large amount of *C. palustris* pollen. Although the marsh-marigold had been believed by many persons to be the cause of May disease, all experimental proof had hitherto been wanting.

F. D.

435. **Renewal of the Combs in Bee Hives.**

AYME, H. *Le renouvellement des rayons. Journal d'Agriculture pratique*, Year 87, Vol. I, No. 2, pp. 32-34. Paris, 1923.

The author has noticed that when bees instinctively realise the necessity of renewing their combs, this knowledge often comes to them rather late, and that man can supply their needs in this respect in a more timely and satisfactory manner. Experience has proved that when a colony does not thrive, in spite of having been provided with plenty of

food and with a young queen, this is to be attributed in nine cases out of ten to the hive being too old, or having been accidentally deprived of its queen, with the result that the central combs serving as brood-combs are in a bad condition. The remedy consists in the removal of all old frames containing neither brood nor honey, and their renewal by new frames. If the old ones contain some honey they can be placed at the ends, but as soon as the brood has hatched out, such defective frames should be entirely discarded. By the adoption of this system, two years are amply sufficient for the complete renewal of the brood-combs in a hive with 12 to 14 large frames. The use of corrugated wax greatly facilitates this operation which, in the opinion of the author, should be carried out every 6 years, though in order to disturb the bees as little as possible, it is well to renew 2 or 3 combs every year instead of substituting 5 or 6 new ones at a time.

The deterioration of the combs is due : to 1) the cavities of the cells becoming reduced in size owing to accumulation of the outer silky coverings left behind by the chrysalides ; 2) the bees, or some of their enemies, gnawing the cells ; 3) the excess pollen deposited by the bees upon the combs surrounding the brood-comb. This pollen decomposes in time and is the chief cause of the necessity to renew the combs. The combs can, however, be cleansed by washing ; they are left to soak for 24 hours in tepid water, after which a small jet of water is directed upon each comb in turn. If the operation is not successful, it is necessary to scrape away the cells with a knife until the corrugated wax is exposed, when the bees will construct new cells upon it in the same manner as they do upon new corrugated wax.

F. S.

Sericulture.

436. Sericulture Improvement in Southern China.

HOWARD, C. V. (Professor of Sericulture, Canton Christian College) the *Lingnaam Agricultural Review*, Vol. I, No. 1, pp. 31-46, 3 tables. College of Agriculture, Canton Christian College, Canton, 1922.

PRESENT CONDITIONS OF SERICULTURE IN SOUTHERN CHINA. — Southern China is more or less isolated, both geologically and ethnologically, from the rest of China. It has little connection with the Northern part of the country and communicates with the Western States almost entirely by means of Shanghai, which explains the fact that silkworm rearing in S. China has not made the progress to be expected from the favourable conditions of the surroundings, the rare quality of the breeds raised, the good type of silk produced, and the excellent organisation of the production and sale of mulberry leaves and of silk.

Most of the silk-breeding treatises, even those written in Chinese, do not consider the question of sericulture in South China, but only deal with the industry as practised in Northern and Central China where the conditions and methods obtaining are totally different.

Sericulture is carried out in the Province of Kwangtung, in the Delta region over an area of about 150 sq. kilometres, between Canton, Hong-

LIVE STOCK

kong and Macao ; in the valleys of the West River and the Kwangsi (as well as in the Province of Kwangsi) ; north of Canton and Swatow ; in the island of Hainan, etc. ; the total area may be estimated at some 1500 sq. kilometres. This area could well be quadrupled, while by the production of healthy " seed " and the selection of the breeds of silkworms reared, the amount of silk obtained from the present sericultural area could easily be increased three or five fold.

Since no statistics are available, it is not possible to estimate the total silk output of Southern China. The reeled silk production for the Province of Kwantung for 1921 has been reckoned at 315 100 pikuls (or about 42 million lbs.). It is certain that the amount of silk used locally far exceeds the quantity exported, but as a rule, the selected cocoons are sold to spinning-factories provided with modern appliances and working for export, whereas the cocoons of second quality are reeled at home and the silk is woven in the local factories.

Canton exports from one half to two-thirds as much raw silk as Shanghai, although its supply area is only one-tenth of the size of the district drawn upon by the latter port, for in Northern China only bivoltine silk worms are kept, while in Southern China six broods are reared annually.

The amount of raw silk exported from Canton rose from 39 789 bales in 1918 to 61 566 bales in 1921 ; during the same period it rose in Japan from 235 822 to 261 265 bales. Canton exported 15 451 bales of raw silk to the United States in 1918 and 48 057 in 1921, the number of bales sent to Europe being respectively 24 338 and 13 509. Canton silk crêpes are rapidly gaining favour in North America.

Canton silk is of a special type and resembles the silks of Tonkin, Siam and India being quite distinct from Shanghai silk, that is to say, from the products of Northern China, Japan and Europe. Its fibre is thinner, softer, more glossy and better adapted for the manufacture of special textile fabrics such as crêpes and velvets.

SILKWORMS REARED. — These belong to two varieties, one bivoltine (bred in the spring), and the other polyvoltine producing six broods annually, the breeding season lasting from the end of January until the end of October. Both kinds of silkworms produce the same quality of silk which is soft and very glossy, they also make the same type of oval, white cocoon, although those of the bivoltine breed are larger and the fibre of the silk is somewhat coarser. The bivoltine variety is called "Taai Tso" and the polyvoltine "Lum Uet"; the latter name has, however also been given to a hybrid between the two varieties which has taken the place of the parent of the same name.

Five weeks elapse between the hatching out of this hybrid and oviposition. The two first generations have thin-skinned eggs of a light colour (cream) and hatch naturally from seven to ten days after they are laid. Some of the eggs of the third generation and all those of the three following layings are dark coloured and have thick skins. They do not hatch naturally until the following January. The immediate hatching of the dark eggs can, however, be induced by their immersion for a few seconds in boiling water on the morning following their deposition. This is a very

delicate operation and only a few persons know how to perform it which is probably one of the reasons for the silkworm "seed" trade in Southern China remaining in the hands of a restricted number of individuals.

Forced hatching is a cause of weakness, and the ill effects are intensified by defective methods of rearing the silkworms which are kept with insufficient space in damp unventilated huts and crowded together in the breeding trays with the inevitable result that the mulberry leaves are wasted and become fermented, etc. This explains why 50-70 % of the "seed" on the market is infected with pebrine and accounts for the slow progress made by the industry.

THE WORK OF THE CANTON CHRISTIAN COLLEGE. — At first, direct propaganda was started among the peasants and an effort was made to insure the production of only healthy "seed", but a great difficulty was encountered in the latter connection chiefly because in the case of the polyvoltine breed there is not sufficient time for the microscopic examination of the eggs, since these must be immersed in hot water the morning after they are laid.

The Silkworm-Rearing Section of the College therefore confined itself to examining only the seed from which its own silkworms were to be reared, and distributed without any inspection the seed obtained from its stock. The result was that febrine increased in every generation, so that while only 0.5 % of the silkworms reared at the College are infected, on an average, the percentage of infected seed proved to be 1 in the case of the distributed eggs, and 50-80 in that of the silkworms produced locally. Further, the silkworms and cocoons obtained at the College were larger than any of the others.

The College began its work in 1919. The first year it had to overcome the prejudice against its "chemical eggs", as they were termed by the natives, and was obliged to sell "seed" at one-tenth of the market price, although now its worth has been realised, it fetches a price four-times as high as all the others and the supply cannot by any means keep pace with the demand. Local dealers purchase, by preference, cocoons produced by silkworms reared from the College eggs.

The College also carried out propaganda by means of short seasonal courses for silkworm rearers and silk reelers, half-yearly competitions, the construction of silkworm breeding huts of the native type but improved at little expense, and by the inspection of the broods raised from eggs supplied by the College, etc. A years' course of instruction is held for the training of the technical Staff.

F. D.

Pisciculture.

437. Restocking Streams.

DE LACHADENEDE. Notice sur le repeuplement des cours d'eau dans le Tarn et sur la Station d'incubation de Lampy. *Revue des Eaux et Forêts*; Vol. LXI, No. 1, pp. 16-21. Paris, 1922.

France imports 4 million kilos of fish every year, which ought to be supplied from her own rivers and streams. It is with this object that the

following efforts have been made in the Department of the Tarn, which has 413 km. of trout streams. They relate to:—

- (1) the production of trout ova;
- (2) their hatching.

Hitherto the ova of Salmonidae have been produced in stations where the breeding fish have been kept in basins. But in this way young fry are obtained which are not hardy. Consequently an attempt has been made to obtain, in a practical and economical manner, ova from breeding fish in a free state. The locality selected was the basin of the Lampy in the Black Mountain. The Lampy stream, which is the only stream fed from this basin, forms a bend down stream. At this point there is a forester's house and a Station has been made consisting of a fishery, confined basins and a hatchery.

1. *The Fishery.* — The bend in the stream has been cut across by a ditch 0.50 m. wide. A net blocks the downstream opening. An elongated basin has been arranged between the entrance and the exit. When the trout go up stream to spawn they pass up the ditch, for the stream is blocked, and they get into the net where they are caught.

2. *The confined Basins.* — The trout which go up stream have not all reached sexual maturity. While waiting until they are mature the fish are kept in two basins of running water, after sorting the sexes. The time when sexual maturity is attained must then be ascertained by frequent observations. For this, the basins are emptied by means of a sluice without however emptying a hollow in which the fish collect and are easily caught in a landing net.

3. *Hatchery.* — 8 double troughs of oak with 2 stages of perforated zinc platforms are fed by a spring whose water has been decanted and filtered. Each trough can hold 26 000 ova per stage. The total content is therefore 400 000 ova. The first results were obtained in 1921-22; but they were spoiled by drought which caused loss and delay in the capture of the breeding fish. From the 11th December to the 24th February, 310 male fish and 398 female fish were caught. The females, which averaged 200 grammes in weight, gave 162 000 eggs. The eggs when kept at a temperature of 4° to 6° C began to hatch after four days.

The mortality varied from 3 to 30 % according to the screens, in proportion to the insufficient sexual maturity of some of the trout and want of aeration in some of the water; clear river water gave better results than spring water.

Small fry Stations. — The small fry were kept in fixed Stations until May. They were then taken to the stream to be restocked. But such transport is difficult and costly.

Moveable stations are formed of transportable cases. Flannel filters are arranged on the side through which the water enters, then a large compartment into which the water enters from below and in which is arranged a screen of perforated zinc half way up. The water passing across the eggs flows out through the upper part of the opposite side. This small and very portable apparatus can be put up anywhere where there is a streamlet and can be looked after by inexperienced persons.

This method of restocking has, moreover, interested the people of the mountains who have seen it in use and its application by them has thus been facilitated. R. D.

438. Purification and Utilisation of Drainage Water by means of Carp Breeding.

LECLERC, M. J. (Inspecteur adjoint des eaux et forêts) *La pisciculture in Alsace Lorraine La vie agricole et rurale*, Year II, Vol. XXI, No. 38 pp.215-216. Paris 1922.

In Strasburg (Wachen) there is an interesting establishment for the purification and utilisation of drainage water. The water is directed through underground channels and filtered through a screen with a 7 mm. mesh which collects a deposit of about 5 % of material. It is then directed into settling tanks with well-sloped sides and narrow base and hollowed out to form a channel. A longitudinal wooden sluice gate is lowered from time to time to close the exit of the channel and the latter consequently acts as a conduit and the force of water drives out the deposit. The water then flows into a well, where fermentation takes place and the matter is rendered soluble and only a small deposit remains which every three months is cleaned out. The sludge is utilised by farmers as a fertiliser.

The water from the settling tanks, still containing 7-8 % foreign matter is mixed in varying proportions with from $\frac{1}{2}$ to $\frac{1}{3}$ its bulk of fresh water coming from another source, and the combined stream of water then flows into the purification tanks, each of which covers 0.5 hectares with an average depth of 1.20 metres. The water is distributed by means of a stone channel, width 0.20 m., with transverse pipes, 6 to 8 metres apart. This assists oxygenation of the water and regular distribution. Overflow exits are arranged.

In the purification tanks a collection of carp fry are placed. The organic material suspended in the drainage effluent results in large swarms of entomostracae, which act as purifiers, and absorb all the organic material, including the bacteria, and the young carp seem to flourish on this form of nourishment.

During the winter the carp hibernate at a depth of 2.5 m., they however, continue their beneficial work, although with somewhat less vigour.

The Waachen centre covers an area of not more than 3 hectares, quite insufficient to meet the demands of the city; this would necessitate some 70 hectares calculated at the rate of 1 hectare per 3000 inhabitants.

F. D.

BIBLIOGRAPHICAL NOTES.

439. ADERSEN, VALD. The Curative Properties of Glandular Serums. Eksperimentelle Undersøgelser vedrørende Kvoerkeserum. *Meddelelser fra den kgl. Veterinær-og Landbohøjskoles Serumlaboratorium LXXXIII*, 13 pp. Sortryk af Maanedskrift for Dyrloeger, Vol. XXXIV, 1922. Stockholm, 1922.

An account of experimental research made in the Serological Laboratory of the Royal Higher School of Veterinary and Agricultural Science

of Stockholm, on the curative action of glandular serums. The results, which are also summarised in German, show these serums to have not only a prophylactic effect, but also a very active curative effect.

F. D.

440. PHILP, T. (Chief Government Veterinary Surgeon), Osteomalaxy in Cattle. *Department of Agriculture, Tasmania, Bulletin* 109, 2 pp. Hobart, 1922.

A short description of osteomalaxy in cattle, its causes, treatment and prevention.

F. S.

441. ADERSEEN, VALD. Kan Serumbehandling forebygge Streptokokpycemia hos. Føl? *Meddelelser fra den kgl. Veterinær-og Landbohøjskoles-Serumlaboratorium*, LXXIX, Soertryk af den Kg. Veterinær-og Landbohøjskoles Aarskrift 1922, pp. 110-132. Stockholm, 1922.

Description of the experiments carried out in the serum Laboratory of the Royal school of Veterinary Hygiene and Agricultural Science, Stockholm to test the value of serums for the cure of the streptococcus pyocemia. The results obtained were negative.

F. D.

442. CHRISTIANSEN M. General Mucormykose hos Svin. *Meddelelser fra den kgl. Veterinær-og Landbohøjskoles Aarskrift* 1922, pp. 133-180, fig. + 2 tables separate from text, bibliography. Stockholm, 1922.

A description, followed by a summary in German, of two cases of general mykosis produced in swine by *Mucoraceae*, one of which was a form very nearly related to, or identical with *Rhizopus equinus* Constantin and Lucet var. *annamensis* P. Noël, while the other was *Absidia ramosa*, var. *Rasti* Ledner (*Mucor ramosus* Lindt.).

F. D.

443. DOMATIEN, A. Les maladies microbiennes des volailles en Algérie. *Revue Agricole de l'Afrique du Nord*, Year 21, No. 186, pp. 122-124; No. 187, pp. 134-136; No. 188, pp. 148-151, fig. 1. Algiers, 1923.

The author describes all the bacterial poultry diseases known in Algeria (bird-pox, contagious epithelioma, fowl diptheria, contagious coryza, ophthalmia, avian tuberculosis, white diarrhoea of chicks, cranp, fowl typhoid) and describes the means of diagnosing these maladies, the samples to be sent to the laboratory and the best control methods.

F. S.

444. DECHAMBRE, P. La consommation des betteraves. (*The consumption of beet-roots*) *Revue de zootechnie. La Revue des Éleveurs*, Year 2, No. 2, pp. 144-146. Paris, 1923.

Practical advice as to the use of beetroots in the feeding of domestic animals with a description of the mischief caused by damaged beetroots.

F. S.

445. RADISSON, M. (Ingénieur agronome, Institut d'agronomie coloniale, Nogent-sur-Marne). Causes et conséquences de la Transhumance chez les tribus du Moyen-Atlas. *Revue de Zootechnie. La Revue des Éleveurs*, Year 2, No. 1, pp. 33-44, fig. 4, maps 2, graphic 1; No. 2, pp. 140-152, fig. 3. Paris, 1923.

The author gives a detailed account of the causes determining the travelling of flocks in the different parts of the Middle Atlas and mentions the advantages that sheep-breeding and colonisation may derive from the practice.

F. S.

446. WILLAERT, L. Flevage et les races d'animaux domestiques dans l'Uelé (Congo Belge). *Bulletin agricole du Congo Belge*, Vol. XIII, No. 1, pp. 3-43, plates 1, figs. 7. Brussels, 1922.

Detailed description of the rearing of domestic animals, under four headings: natural distribution considered from the stock raising standpoint; domestic breeds (cows, sheep, goats, horses, donkeys, mules, poultry); hygiene diseases; of animals.

F. S.

447. PARENTI, E., Allevamento e razze di animali domestici nell'Uelé (Congo belga). *L'Italia agricola*, Year 60, No. 2, pp. 81-82, 1 table. Piacenza, 1923.

A brief review of the breeding of the Belgian horse in Italy which was begun in 1907 in the Province of Piacenza, and in 1908, in that of Cremona. Belgian horse-breeding centres are confined to the Provinces of Cremona, Mantua and Piacenza whence the animals are sent to the neighbouring Provinces of Bologna, Ferrara, Alessandria and Vercelli.

The author gives the names and addresses of some of the best breeders.

F. D.

448. OTTO, Die Brennpunkte der Gemeindebullenhaltung. The Main Difficulty in Community Bull-Keeping. *Deutsche Landwirtschaftliche Tierzucht*, Year 26, No. 49, pp. 517-518. Hanover, 1922.

The crux in the keeping of a common stud-bull lies, according to the author, in the great difficulty, owing to the constant fluctuations of the exchange, in fixing a service-fee proportionate to the maintenance cost of the animal. He therefore suggests that the service-fee should be paid in kind, and preferably in forage, which is the chief item in the expenditure.

F. D.

449. BARBIER, A. (Directeur des Services vétérinaires de la Côte-d'Or). La Race Tarantaise et son Concours spécial en 1922. *Revue de Zootechnie*, No. 5, pp. 486-498, figs 5, bibliography. Paris, 1922.

On the occasion of a special show of the Tarantais breed held at Chambéry, the author gave an account of the origin of these cattle and described their characters and breeding. He also mentioned the improvements that might be made in the animals, and the markets for their products. The article contains the scale of points adopted at the Show.

F. S.

450. DECHAMBRE, P., La Production bovine de la Bretagne. *Revue de Zootechnie. La Revue des Éleveurs*, pp. 94-102, fig. 4. Paris, 1923.

A study of the natural surroundings (soil and climate) of the cattle of Great Britain, together with an account of the distribution of the breeds and the differences shown by the stock owing to crossing and the admixture of races. Suggestions for the improvement of cattlerearing in Great Britain. F. S.

451. ROSE, H. A. Belted Galloways. *The Scottish Journal of Agriculture*, Vol. VI, No. 2, pp. 163-166, figs. 4. Edinburgh, 1923.

A short account of the development of the Belted Galloway breed of cattle. The author gives the characteristics and capacities of the present animals and states that a Herd-book is being started. F. S.

452. Ministry of Agriculture and Fisheries, Leaflet, No. 388. The Feeding of Dairy Cows, pp. 10. London 1923.

This leaflet contains a practical account of the rules to be observed in feeding dairy cows, and gives examples of the composition of maintenance and production rations in winter and summer, the method of estimating the feeding value of such rations, the effect of certain foods on milk and butter, and of certain preparations on the digestibility of food. It also provides a list of the chief feeds showing their digestible starch content, starch value and nutritive proportions. F. S.

453. SPÖTTEL, W. and TÄNZER, E. Über Eigenschaften und Vererbung der Wolle bei Leicester-Merino-Kreuzungen. The Wool of Leicester-Merino Hybrids, its Characters and their Transmissibility. *Deutsche Landwirtschaftliche Tierzucht*, Year 26, No. 49, pp. 518-522, 1 fig. Hanover, 1922.

A critical review of the work of preceding investigators and an account of the authors' own researches as to the characters of the wool of hybrids resulting from the Leicester-Merino cross and the extent to which the parental qualities of fleece are inherited by the offspring.

A careful study of the fleeces of pure-bred Merinoes and Border-Leicesters and of the fleeces of their crosses shows that it is a mistake to suppose that the wool of the hybrids is composed of more numerous or more variable types of fibres than the wool of the parent breeds.

F. D.

454. LAWRENCE, E. (President of the Devon Long-Wool Society). Devon Long-Wool Sheep. *The Journal of the Ministry of Agriculture*, Vol. XXX, No. 2, pp. 126-129, figs. 2, London, 1923.

This paper gives an historical account of the Devon Long-Wool breed of sheep, describing its characters and aptitudes, and the points requiring special attention in the selection of the rams and ewes. Mention is also made of the places and dates of the chief markets where the rams of this breed are sold. F. S.

455. FRANCIS, P. A. (Ministry of Agriculture and Fisheries). The Importation of Continental Goats. *The Journal of the Ministry of Agriculture*, Vol. XXIX, No. 11, pp. 1023-1028, figs. 4. London, 1923.

The author takes advantage of the arrival in England of a consignment of Saanen and Toggenburg goats, to give some information on the subject of these two breeds which are largely reared in Holland and Switzerland. F. S.

456. SANDERS, SPENCER. The Tamworth Pig. *The Journal of the Ministry of Agriculture*, Vol. XXIX, No. 11, pp. 1029-1032, figs. 2. London, 1923.

The present type of Tamworth pig is described and the standard given as established by the National Pig-Breeders' Association F. S.

457. VOITELLIER, CH. Exposition Internationale d'Aviculture de Paris. *Revue de Zootechnie. La Revue des Éleveurs*, Year 2, No. 3, pp. 289-246. Paris, 1923.

Observations made on the subject of poultry-rearing in France on the occasion of the International Avicultural Exhibition at which nearly 10 500 head of French and foreign poultry were shown. F. S.

458. HARDY, F. W. The Intensive System of Poultry Keeping *The Journal of the Ministry of Agriculture*, Vol. XXIX, No. 11, pp. 1001-1008 figs. 2. London, 1923.

This paper gives the chief rules to be observed in housing, feeding, supplying water etc. to fowls with a view to intensive poultry-keeping. It also contains information respecting the building of fowl-houses, the composition of rations and other matters of interest. F. S.

459. RUSTON, A. J. (Lecturer in Farm Economics, University of Leeds). Poultry-Keeping on the Farm. *The Scottish Journal of Agriculture*, Vol. VII, No. 2, pp. 166-176, tables 5, figs. 2. Edinburgh, 1923.

A review of the economic condition of the egg-production industry in Yorkshire (England), together with some hints as to the better management of laying hens. F. S.

460. Ministry of Agriculture and Fisheries Leaflet No. 321, Notes on Essential Points in Poultry Feeding, 2 pp. London, 1923.

Revised edition giving useful and practical information on the feeding of poultry and the preparation of dry and moist feeds. F. S.

461. *The Agricultural Gazette of Canada*. A System of Pedigreeing Poultry Vol. X, No. 1, pp. 40-45, figs. 9. Ottawa, 1923.

The author gives the scale of points for controlling and marking fowls belonging to laying breeds which has for several years been followed with complete success by the Poultry Husbandry Department of Macdonald College. F. S.

462. LADEBECK, E. Die Farben einiger Hühnerrassen. *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, Vol. XXX, Parts 1-2, pp. 1-62, bibliography. Berlin, 1922.

This article on the colouring of different breeds of fowls includes: an account of the morphology of the feathers and of the pigments of the plumage, a comparative chemical study of the different pigments, and a description of the colour of the comb, ear-lobes and feet. It is a contribution to the solution of the problem of the isolation of the various hereditary factors of a transmissible character, which is in this case the colour of the plumage.

F. D.

463. RICHARDSON, E. C. Recent Developments of Rabbit-Keeping for Fur. *Journal of the Ministry of Agriculture*, Vol. XXIX, No. 11, pp. 1019-1023, figs 3. London, 1923.

A description of the present condition of the industry of breeding rabbits for fur, and of the rabbit fur trade in England.

F. S.

464. GIRARD, H. (Président du Club français du Chien de berger) Nos Chiens de Berger. *Journal d'Agriculture pratique*, Year 89, Vol. I, No. 13, pp. 257-259, figs. 2. Paris, 1923.

In this article, the author urges the farmers of France to rear fine, pure-bred sheep-dogs instead of mongrels. He draws attention to the fact that there are about 10 million head of sheep in the country which, at the rate of 1 dog for a 100 sheep, means work for 100 000 sheep-dogs.

F. S.

FARM ENGINEERING.

Machines and Implements.

465. A Tractor worked on Palm Oil.

GASTHUY, P. Rapport sur le concours de Tracteurs à l'huile de palme organisé par le Ministre des Colonies à Bruxelles, en 1920-1921. *Bulletin des Matières Grasses* (reproduced from *Bulletin Agricole du Congo Belge*), No. 2, pp. 49-63. Marseilles, 1923.

In September 1921, at the Exhibition of Colonial Tractors organised by the Belgian Colonial Office, the Stockholm firm, SVENSEN, exhibited a tractor worked on palm oil, called the "Avance" tractor.

This tractor-plough which is described in detail, weighs 2900 kg. and consists of two breasts which are easily regulated automatically,

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for lifting and earthing and are attached to the frame by means of strong springs. If the plough encounters an obstacle the springs yield and the engine is disconnected immediately; this renders the tractor inactive which prevents damage, especially on dry, hard soils such as are met with in the Colonies.

This semi-Diesel two stroke engine is easily worked, durable and suitable for use with vegetable oils, petrol or paraffin. A special cylinder is supplied for palm oil and other fatty fuels, of the consistency of butter or solid, and an aluminium reservoir for the liquefaction of fatty substances. The heat which is transmitted from the cylinder to the walls of the reservoir is sufficient to melt the combustible substance.

Tests. — The engine is of the single cylinder type, upright, double stroke, provided with a heat bulb (partly cooled) and arrangements for an air blast. The characteristics are: 10 HP normal; diameter of cylinder 174 mm.; piston stroke 186 mm.; number of revolutions 550 p. m. When palm oil is used as fuel this is calculated at 579 revs. per minute, which is, according to pulley strength 9.96 HP.; fuel consumption from 322.4 gm. per b. h. p. per hour.

Using heavy mineral oil, the number of revolutions is estimated at 572; pulley strength of motor, 10.08 HP.; fuel consumption 261.9 gm. per b. h. p. per hour.

No deviations were noted during the 30 minutes trial.

Practical trials. — The tractor moves automatically along the ground at a rate of 3.8 kilometres per hour, gives no trouble and does not cut up the roads over which it passes.

a) *Ploughing tests.* — On September 6, tests were made, using petrol, along the edge of a field of heavy soil, beaten down in places by the passage of vehicles and extremely hard after 6 months of severe drought. The details of the work were as follows: 1 hectare ploughed in 5 hrs. 45 min. to a depth of 14-16 cm. at a uniform speed of 3.6 km. per hour. fuel consumption of heavy oil, 19.05 kg. or 21.9 litres (cost. 30 centimes per litre) Hence, the cost of fuel is considerably less than for petrol, with which the results compare favourably.

On September 7, tests were made with palm oil. Under the same conditions, the fuel consumption amounted to 23.4 kg. of palm oil. This was crude and very impure. The double filter reservoir worked excellently and during the 4 ½ working hours there was no interruption caused by any obstruction in the compressor.

b) *Road trials.* — The tractor, apart from the plough, was attached to a farm wagon with 3 wheels, weighing 700 kg. and carrying a load of 1000 kg. On the firm road, the towing proceeded satisfactorily, but on the sand, the wheels sank to a depth of 26 cm., as the steel tyres are too narrow, the front wheels being only 0.70 m. As in the Congo sandy soils are abundant, it will be advisable to make both the back and front wheels of greater width, and of heavier weight, which would assist handling at turnings. At the exhibition at Shrawardine (England), this machines made an excellent impression owing to its durability, simplicity and low run ning coat.

R. D.

466. The Valude Wheel.

Recherches et Inventions, Year 4, No., 47, pp. 197-200, figs. 3. Paris, 1923.

VALUDE has devised a wheel which allows powerful tractors and engines towing heavy weights to travel with the same ease on different soils, or on the highway. This wheel possess two systems of rolling that come into action in turn, automatically, according to the character of the ground.

The VALUDE wheel has a polygonal rim, upon the circumference of which are arranged segments of a trapezoidal form. These segments are placed perpendicularly to the lateral surface, and directed towards one of the diagonals of each rectangle formed by the successive planes of this surface. The edges of these segments thus form practically a continuous and circular rolling way, each segment beginning to roll as soon as the preceding one is entirely disengaged. On the road, the contact would be assured exclusively by the circular, exterior way and its rolling band. On hard, but slippery, ground (such as grass-land), the rolling segments being oblique, prevent skidding. On loose ground, the circular segments penetrate into the soil, and the wheel rests on both sides of the rim. It may be observed that this mode of propulsion does not displace, or dig up, the soil like that of wheels made on the paddle-system, while the top of the rim, after turning on the pivot, comes out of the ground without throwing any soil behind it.

The VALUDE wheel (See Plate XXVI, Fig. 88) has been mounted on agricultural tractors and trials have been made at the works of the P. O. E. M. L. A. Society, at Villeteuse. The use of these wheels caused no serious impediment to the progress of the tractors. Dynamometric comparative experiments conducted with VALUDE and ordinary wheels with gripping rims showed that the VALUDE wheels are in no wise inferior to the present types of wheel from the point of gripping, while they have the advantage of travelling on the road without any preliminary adjustment.

Other tests made at Pierrefonds proved that in order to avoid the lateral displacement of the apparatus as a result of the strain of traction, the segments on the rims of the two wheels must be arranged in symmetrical positions, and not placed parallel.

Finally, experiment has proved the ground covered by the tractor to be somewhat less than the distance covered on the soil by the polygonal perimeter of the wheel, and *a fortiori*, of the external revolving circumference. This slipping is of a kind to cause great loss of power. It may, however, be assumed that the improvements to be made on this, the first model, will prevent this loss of headway. R. D.

467. Plough with Tractor for Level Ploughing.

DESSAISAIIX, R. *Journal d'Agriculture pratique*, Year 87, No. 11, pp. 218-220, figs. 2. Paris, 09 2.

French agriculturists generally consider that level ploughing is necessary for good tillage. Further, the use of mechanical tractors has given rise to the demand for machine-drawn ploughs capable of ploughing in

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the same way as a double two-way plough drawn by a team. The Vêga plough has been devised by BOICHER to meet this demand.

It is modelled on the ordinary double two-way plough, but as the work of turning two or three shares at the end of a furrow cannot be carried out by a driver, the tractor is made to turn the plough when it turns itself to begin the new furrow. At this moment, the tractor makes a rotatory movement (in relation to the plough round a vertical axis) and this motion being transformed into a rotatory motion of the beam causes the body of the plough to return, the driver having merely to move a bolt by means of a wire.

The plough (Plate XXVII, Figs. 89 and 90) consists of the body of a two-way double-plough mounted on a frame with a cranked axle. The far end of the beam which extends beyond the collar carries a bevel-pinion engaging with a part of the cogged rim of the frame. When the tractor turns, it takes a slanting position as regards the plough, and at the same time, makes the frame oblique to the beam. This deviation causes the beam to rotate, and hence return. At the same time, the support, in assuming a slanting position, exerts tension on a chain which causes the rotation of the cranked axle, and raises the plough lifting it free of the soil. The depth of ploughing is regulated by the rotation of the cranked axle. Pawls introduced on the collar keep the chassis vertical in spite of variations in the depths of the ploughing.

R. D.

468. The Use of a Manure Spreader.

TAYLOR. *Farm Implement News*, Vol. 43, No. 31, p. 20. Chicago, 1922.

Dr. TAYLOR, Director of the Experiment Farm of Messrs. DEERE, explains the advantages of a manure distributor. The apparatus insures the manure being economically spread, and it saves time, as well as increases the returns; this has been proved by the comparative experiment made by a farmer of Indiana who sowed maize, oats and clover on different plots, after first spreading the same amount of manure (12.5 tons per acre) by machine and also by hand. The results obtained are set out in the following table.

Crops	Area	Yield per acre		
		manure spread by machine	by hand	unmanured
Maize	10 acres	155 bushels	125 bushels	100 bushels
Oats	10 acres	140 "	105 "	95 "
Clover	10 acres	7.5 tons	5.5 tons	3.75 tons

G. B.

PLATE XXVI.

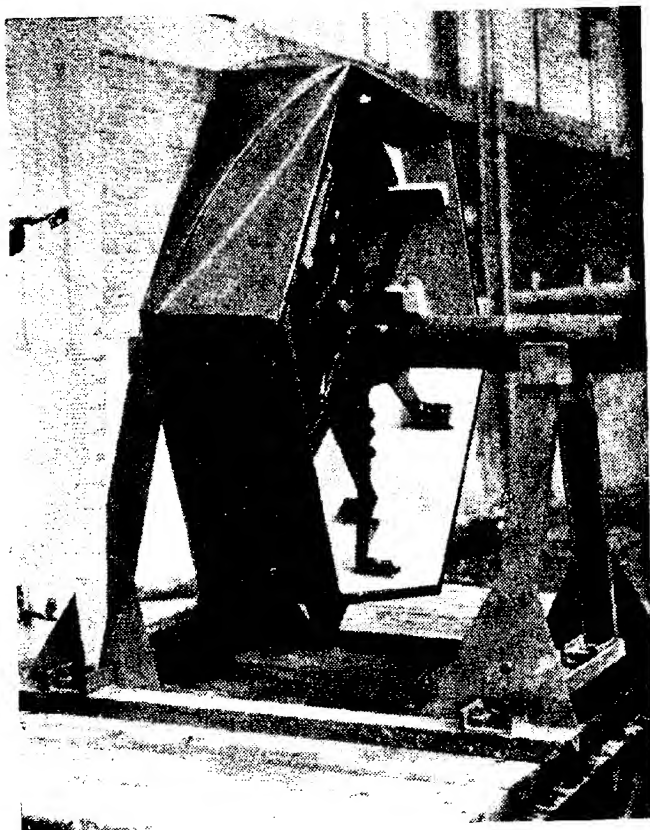


Fig. 88. — VALVE wheel system.

PLATE XXVII.



Fig. 89. — Boichnors' «Vega» plough in working position.

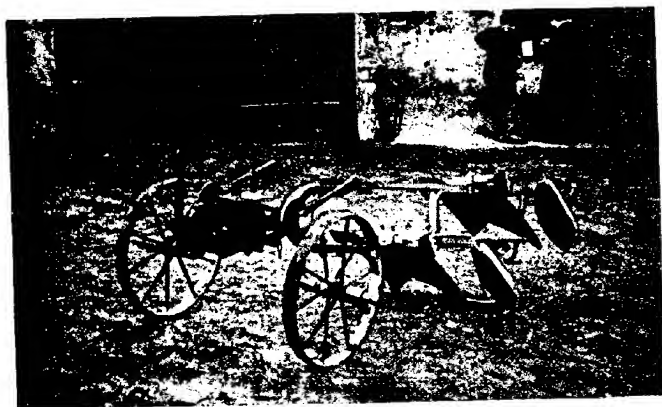


Fig. 90. — Boichnors' «Vega» plough when turning.

469. Harrows for Meadows.

MAURIN, G. Herse pour Prairies. *Journal d'Agriculture pratique*, Vol. 39, No. 4, p. 49. Paris, 1923.

The extirpation of moss is an operation which is generally carried out in the months of February and March.

DE LAPPARENT makes the following statement: — "In order to encourage the diffusion of the considerable reserves of nitrogen that meadows create in the soil, it is necessary to promote the introduction of air by means of mechanical work. If there is an excess of moss it can be removed by sprinkling 200 to 400 kg. of sulphate of iron per hectare and using a special form of harrow with very closely set teeth".

For getting rid of moss the work of an ordinary harrow is very uneven but much better results are given by what is known as chain harrows fitted with teeth in the form of colters and knives. An example of this type of harrow is given in the figure annexed (Fig. 91). The harrow consists of a collection of a certain number of components in the shape of a V with curved arms joined by means of rings. Each part is fitted with three teeth, one in front and two behind. The average dimensions of the furrows made by the teeth is 21 mm. The five types at present manufactured have a dimension of 1.15 metres and the following number of teeth respectively: 54, 66, 78, 90 and 102, while the average weights are 50, 60, 70, 80 and 90 kg.

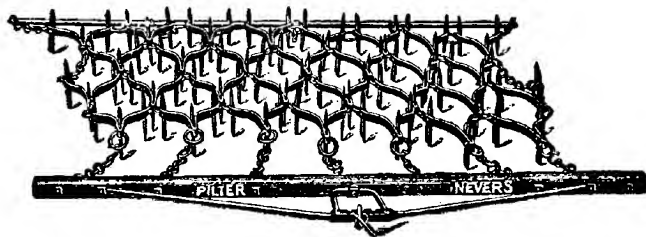


FIG. 91. — Harrow for meadows.

The different parts of the harrow are joined in front to a connecting bar made of angle-iron, and behind to an iron bar which keeps them apart though allowing the necessary amount of free movement. The teeth are in the shape of a colter on one side but more blunted on the other and have pointed ends so that they can be used for light harrowings of cereals at the end of the winter and for burying seeds scattered by hand over the surface of the soil.

E. P.

[469]

470. Equipment adopted in Sweden for the Field-Testing of Fertiliser Requirements.

VON FEILITZEN, HJ. *Nogra tekniska hjälpmedel vid utförande av Lokala fältförsök. Meddelande Nr. 228 från Centralanstalten för försöksväsendet på jordbruksområdet, 32 pp. figs. 30. Stockholm, 1922.*

The chief aim of the so-called local, field fertiliser tests in Sweden is to show each farmer what fertilisers his land requires. These tests are carried out under the directions of the Agricultural Societies of each district and by means of their employees. In order to centralise this work and render it to a certain extent more uniform, an arrangement has been made with the Central Agricultural Experiment Station of Stockholm, so that the details of the experiment schemes are worked out in collaboration with the station, to which the results obtained are communicated. The Station then reports upon each of the experiments made, recommends the most suitable fertiliser to be used and finally elaborates the material collected throughout the country, which is embodied in an annual report.

With the object of simplyfying and thereby rendering more accurate, the field-work entailed in planting, manuring and harvesting the experiment plots, the author (who was entrusted with the direction of this section at the Central Experiment Station in 1921), distributed to the organisers of the experiments a series of previously-tested implements some of which were of a new type. The Bulletin in question gives a detailed description of these implements.

One of the first conditions of obtaining useful results is that the soil should be as uniform as possible. In order to determine its character and homogeneity a borer must be used. The GERSON drill-borer made by Messrs FUNKE and Co., Berlin, has proved very well-adapted to these field-experiments. A sample-taker 35 cm. long, devised by the author, is recommended for taking soil-samples required for testing the reaction (acidity, or alkalinity).

The character of the soil of the experiment fields must be determined and described as clearly as possible in order that comparison may be made between the data of the various results. For this reason, on the initiative of the author, a collection has been made at the Swedish Geological Institute, of samples of all the most important types of Swedish soils. Small samples from the collection are distributed, packed in easily-transported boxes and accompanied with explanations and a description of the composition of each soil.

For the determination of soil acidity by the COMBER method, the author has invented a so-called Field Laboratory that enables analyses to be made easily on the spot. In the case of alkaline soils, it is necessary to estimate their calcium carbonate content which can be done from their greater, or less, effervescence in the presence of acids. A drop-bottle of hydrochloric acid is used for this purpose in the field. It should be carried in a wooden case similar to that used for fountain-pen ink-bottles.

Various goniometers are used in surveying, but the author recommends one with a pentagonal prism as being easy to handle and accurate. The

different plots of the experiment field are marked out with a measuring-tape of 650 m. that, for greater convenience, is wound round a specially constructed spool.

Ribbon-gauges of steel, or of material in which metal threads have been sewn, can be substituted so as to insure greater exactitude in measuring out the plots; the latter type is preferable, for it is cheaper and sufficiently durable.

The limits of experiment plots for cereals, or leguminosae, may be traced out satisfactorily with the "Planet Junior Firefly" plough with forecarriage. A good manure-spreader is made by J. A. ROSE of Gjörding (Denmark), which only cuts a small furrow in the grassland.

The chemical fertilisers for each plot are weighed in little bags and sent to the place where the experiment field. The bags may be easily filled by the use of a funnel invented by L. ANDERSON (Director of Experiments) of Örebro.

Weighing-machines of different makes are used for weighing the harvest (sheaves, green forage, grass, hay, potatoes, roots). The author has carried out exhaustive tests with various types of Swedish and foreign instruments. The results, which have been published, show that the best and most accurate form for field-work is the weigh-bridge with sliding weight fixed into a graduated arm made by Messrs VIRG and VRAALSEN of Christiania. Most of the weighing-machines are not sufficiently accurate.

The Agricultural Section of the Central Experiment Station has worked out a colour scheme for the registration of field experiments which has succeeded admirably, greatly facilitates the further study of the material and makes it easier to draw conclusions from all the data collected.

Samples of beet, for the determination of the percentage of dry matter, may be obtained by a simple machine-cutter constructed according to the Danish model, which makes it possible to cut a large number of slices off a corresponding number of beets. A special drum washes the roots before the sample is taken.

The starch content of potatoes is determined in the simplest field experiments, by means of REIMANN's hydrostatic potato-weigher which gives the specific gravity of the tubers.

In conclusion the author advises that those engaged in country work should use motor-cycles, so as to enable them to carry out more experiments.

The Bulletin is illustrated with numerous photographs of the various apparatus and implements described.

(*Corr. Sweden*).

471. **Farmers' Milling Machines: Tests Carried out in Denmark.**

CHRISTENSEN A. with the Collaboration of BILLESTRUP TH. and FRIIS SOPH. Arbejds prøve med Kvoerne paa Landbohøjskolen i Vinteren 1921-22.

[471]

Statens. Redskabsprover 28 Beretning, 118 pp. figs. 4. Copenhagen (August Bangs, Boghandel), 1922.

The 28th Report of the State Commission for Agricultural Machinery deals with the milling tests made at the Copenhagen College of Agriculture in 1921-22.

In reply to a circular, the following types of mills were entered for the tests:

- a) Mills with top rotation: mills composed of horizontal grindstones of which the upper one revolves.
- b) Mills with bottom rotation; composed of horizontal grindstones of which the lower revolves.
- c) Vertical mills: mills with vertical grindstones, one of which revolves.
- d) Mills with vertical steel disks one of which revolves.
- e) Roller-mills with corrugated cylinders.

All the mills were tested in the machine department of the Agricultural College under the best conditions. Since it was necessary, before testing the work of the machines, to know the degree of milling usually adopted in the industry, ground samples were collected from various parts of the country for comparison. To ascertain the degree of milling, at least 3 sieves with respectively 2 — 1 — 0.5 mm. meshes were used. If the meal passing through the 5 mm sieve was reckoned, 4 grades were obtained. All the mills were tested with maize, barley and oats, and the same degree of fineness was aimed at in each case, for only by this means was it possible to compare the efficiency and energy consumption of the various machines; therefore model samples of maize, barley and oats were prepared. In the case of maize, it was decided that only 37 % of the material ground should be less than 1 mm. in diameter; this sample was a little finer than the average of those taken as the latter were considered too coarse. Only 31 % of the milled barley and 60 % of oats were to exceed 1 mm. in diameter. In judging the results however, a limit of error of 3 % was allowed in either direction as compared with the model sample. All the mills were worked by a 10 H.P. continuous current engine. The power used by each mill was estimated as follows. The kilowatt-hours of energy consumed by the engine in the different trials were ascertained; the watt-consumption was calculated on the basis of the length of the test, then, the energy directly consumed by the mill was calculated from the resistance curve. The relation gives the consumption of energy in kilowatt-hours per 100 kg. of material ground.

In all the mills with grindstones, the latter were made of artificial stone, the composition being a trade-secret of the various firms. This secrecy however, extends only to the mixture and fineness of the constituents of which the most important are magnesia, magnesite and fire-clay. Owing to the short time the tests lasted, it was not possible to decide which stone was the best and which system of mounting was to be preferred, but it is known that the mounting has a great effect upon the energy consumption, as well as upon the rapidity of the milling and the

amount of material ground. Since on a farm it is necessary to use the same mill for grinding various kinds of cereals to different degrees of fineness, the mounting selected must answer all requirements. The report gives examples of various systems of mounting. The following information has been taken from the "General observations" of this report.

a) *Mills with revolving upper-grindstone* (8 of these were tested). In the old type, the revolving grindstone was so heavy as to be able to grind the grain by the effect of its own weight. Some of the new type of mills tested had such a thin, light revolving grindstone that its weight alone was not sufficient to crush the corn, and a spring arrangement underneath was provided, to press the revolving grindstone against the lower grindstone. Mills of this kind are lighter than those of the ordinary type and work regularly and silently, but although the pressure of the spring can gradually be relaxed as the resistance to be overcome decreases, these mills are not so simple as the old type in which the revolving stone grinds by means of its own weight.

b) *Mills with revolving lower grindstone* (8 of these were tested). When equal in size, these mills give a larger output than the preceding kind. They work regularly and without noise but, as in the case of mills with revolving upper grindstone having a horizontal bar fixed to the pole, the pivot of the revolving stone must turn round within a hinged support. The millstone-bridge is not as simple as that of the old type and probably this new type of mill will prove less durable than the original one.

c) *Mills with vertical grindstones* (6 were tested). These machines are frequently well designed, they take up little room and their output is large. Naturally, the grindstones wear more than those of the larger mills, for they have to do the same work over a smaller surface, but they are easily mounted, so that most farmers could change the stones, and a new stone costs little. Since the construction of these mills is slightly more complicated, they will probably not last as long as ordinary mills with revolving upper grindstone.

d) *Mills with vertical stone disks* (3 were tested). (These are very primitive and their chief merit is their low price. In all the machines exhibited the disks were mounted obliquely, therefore when worn, they cannot be reversed, or replaced. In the milling test, this type of mill turned out a coarser barley meal than the model sample, but the maize and oats could be milled sufficiently fine.

If the material is ground twice, the meal is quite satisfactory.

e) *Roller-Mills* (3 were tested). When well-made these mills are excellent and work more cheaply than those with grindstones. As however, their construction is more complicated than that of the stone-mills, their duration is shorter and they need more careful handling.

All the mills were able to grind maize, barley and oats. Mills with grindstones, or vertical disks, do not grind the oleaginous seeds of lupins well, as they crush them into paste instead of meal. Roller-mills can deal also with lupin-seeds (although with difficulty) if the cylinders are revolved rapidly.

The description given of the tests is very exact and exhaustive ; and the report is illustrated with diagrams showing nearly all the apparatus and their grindstones (in order to demonstrate their mounting). In some cases the construction, millstones and working are described in detail. A summary of the results of the experimental tests and the opinion of the expert is given for each machine. The following is a specimen form.

" Element ". Horizontal, revolving lower grindstone of artificial cement, 500 mm. in diameter. Brødrene, Larsen, Assa.

Speed at periphery 9.6 m. per second. Power required when running light 0.24 H.P.

No. of test	Cereal milled	Amount ground per hour.	Consumption of energy		Current used to grind 100 kg. by means of the 80 % electro-motor	Temperature of the machine	Degree of Fineness				Difference as compared with standard sample + finer - coarser
			average	per % kg. of cereals			above 2 mm.	from 1 to 2 mm.	from 0.5 to 1 mm.	below 0.5 mm.	
	kg.	H. P.	H. P. hours	H. P. hours	Kilowatt hours	°C	%	%	%	%	
1	Maize	644	8.2	1.27	1.171	19	4	20	33	43	+ 13
2	"	644	7.2	1.12	1.029	17	6	25	32	37	+ 6
3	"	672	7.3	1.09	1.000	16	7	30	29	34	0
4	"	672	7.0	1.04	0.958	16	8	33	28	31	- 4
5	Barley	360	7.3	2.03	1.865	21	2	10	40	39	+ 10
6	"	472	8.0	1.69	1.659	19	2	30	36	30	- 1
7	Oats	392	7.5	1.91	1.750	25	35	25	19	20	- 1
8	"	392	7.3	1.86	1.713	25	35	28	18	19	- 3

The numbers in heavy type give the results of tests in which the milling was as fine as in the standard sample. There alone must be considered in comparing the energy used by the different mills.

The experts' opinion. The mill which is entirely of iron is extremely well made. When supplied with clean grain, its work is certain and regular ; in the case of barley or other cereals with husks, the mill grinds less regularly. The lower millstone is very securely fixed. The hinged support of the pole is solidly fastened both as regards the foot and the pivotted neck, as it is strengthened by cast-iron blocks and a supporting-plate also of cast-iron. A convenient feature is the possibility of removing the cloth that forms the hood, without displacing the lower grindstone.

The amount of current used in grinding 100 kg of cereals exceeds the average of the tested mills with grindstones by 7.3 H.P. and 12 watts for maize ; 8 H.P. and 34 watts for barley and 7.5 H.P. and 310 watts for oats.

The mill grinds 372 kg. of maize per hour with 7.3 H.P. ; 472 of barley with 8 H.P. and 3.92 kg. of oats with 7.5 H.P. The sacks are easily changed owing to the mill having two apertures both provided with

rings for strong straps which do not injure the sacks. The mill is an excellent one; and thoroughly well constructed, and is adapted for an engine of 7-8 H.P.

Some experiments were made to show the effect on the energy consumption: 1) of the amount of material ground; 2) of the fineness of the milling; 3) the perimetric speed.

1) The experiments conducted with a mill carrying a vertical stone of cement showed (what was afterwards confirmed by tests made with other types of mill) that the machine worked with the greatest economy e. g. with minimum power consumption for a given charge, if the charge consisted of 275 kg. of maize an hour.

2) Three series of experiments were made with different types of mill having respectively: a revolving upper grindstone; a revolving lower grindstone; a vertical grindstone. It would have been very useful to have been able to learn from the tests how much power was required for a percentage increase in the fineness of the milling; this is not shown by the table of results, from which it is seen that this relation is not constant, but varies with the kind of cereal and the mounting and size of the grindstones, as well as with the perimetric speed. The figures do, however, show that the consumption of energy rapidly rises with the increased fineness of the milling.

3) Some experiments were made with two mills, one carrying an upper revolving grindstone and the other a lower revolving grindstone. The periphric velocity was regulated according to the speed necessary for milling oats, since a little greater, or less, degree of velocity is not so important in the case of either maize or barley. (*Corr. Denmark*).

472. Chopped Rice Straw as a Feed for Cattle.

TARCHETTI, A. *Il Giornale di Riscoltura*, Vol. XII, No. 10, pp. 155-175, 1 fig.; No. 11, pp. 173-176, 1 fig.; No. 12, pp. 185-187. Vercelli, 1922.

The advantages of using chopped green food (especially when fibrous) in feeding cattle are generally recognized. Accurate figures, however, are not available for determining the necessary degree of fineness in relation to the type of crop and of animal to be fed; the proportion in which chopped should be mixed with ordinary feeds; the manner in which it should be fed etc.

Rice straw fed alone to cattle is not, generally, acceptable, on account of the excess of silica contained; it is perhaps also indigestible and consequently injurious, but mixed with concentrates and more nutrient feeds, such as dregs of pressed grapes, whey, hay, mangolds, potatoes, rape, etc. it becomes, owing to its power of absorption, an excellent feed, better assimilable by the digestive organs than concentrates alone, and therefore more acceptable. At the present time a great deal of this straw is wasted where rice is grown and the author refers to machines made by A. Squassi, which make rice straw chopping an inexpensive process and its use as forage consequently profitable. These machines include 3 types (of 3 — 5 — 8 HP respectively) of disintegrators and 3 types (3 — 5 —

8 HP) of pulverisers. Each consists of a cylindrical case containing strong steel plates, against which the material to be chopped is forcibly driven by a revolving drum, co-axial with the case and fitted with the necessary points and hammers; between the plates are arranged, readily changeable metal gratings through which the chopped product is discharged. In the pulverisers the points are rigidly fixed on the rotating drum; in the disintegrators they are more loosely attached.

F. D.

473. The Importance of the Type of Feed-Water for Boilers in Dairies.

A. F. Die Bedeutung des Kesselspeisenassers für Molkereien. *Molkerei-Zeitung*, Year 37, No. 1, pp. 1-2. Hildesheim, 1923.

In every case, care must be exercised that the boiler is not rapidly destroyed by the water supplying it.

River water contains a larger or smaller percentage of mechanically transported material; after filtration the water is excellent for supplying boilers, since it contains few substances in solution, or at all events, many fewer than are present in subterranean water.

While the substances mechanically mixed with water are comparatively easily removed, it is much more difficult to get rid of those in solution.

The most important salts forming such deposits are:— Magnesium carbonate; calcium carbonate; magnesium sulphate; calcium sulphate.

Different waters vary greatly as to the presence and amount of these salts to which their hardness is due; 1 degree of hardness (German scale) corresponds to 1 gm. of calcium and 0.7 gm. magnesium in 100 litres of water.

The size of the boiler is a very important factor in determining the water that can be used; for a boiler of large capacity, the feed-water may have 10 degrees of hardness, but if the boiler is small the water must be softened, even if its hardness is only 6-7 degrees. The calcium carbonate and magnesium carbonate separate out during the process of boiling and form a deposit. Temporary hardness can be removed by heating the water to 80°-100° C. and adding at the same time some caustic lime, or caustic soda; 1 kg. of calcium must be added per 1000 litres of water.

Sulphate of lime and sulphate of magnesium can be removed as a deposit by boiling the water and adding some calcined soda in the proportion of 1.9 gm. the every 100 litres of water to be softened. Care should, however, be taken not to introduce too large a quantity as this immediately induces the formation of froth. It is very advisable to add a soda solution until a faint blue coloration is produced on litmus paper. The litmus-paper test should be applied every day.

Condensed water is also very suitable, as its heat can be utilised again and it is free from all deposit-forming, or encrusting matter, care must, however, be taken to see that it does not contain any oil, which is very injurious to boilers; as a precaution, this water should be passed through a Koks filter, or through wood wool.

E. P.

BIBLIOGRAPHICAL NOTE.

474. WESTRA, J. G. Uitkomsten van een rooioproef in het Djatibeheerscomplex Gedangan (Java) in 1921-1922. *Tectona*, Part XV, No. 12, pp. 1111-1116. Buitenzorg, December 1922.

Results with a new stump puller in the teak forest district Gedangan (Java) in 1921-1922. D. V. S.

AGRICULTURAL INDUSTRIES.

Plant products.

475. "Moskonfyt" Syrup from Pure Grape Juice.

VAN NIEKER, S. W. (Government Viticulturist). *Journal of the Department of Agriculture, Union of South Africa*, Vol. VI, No. 4, pp. 315-319. Pretoria, April 1923.

A summary of the manner in which moskonfyt syrup is made on the farm in South Africa. Must from grapes pressed the same day is extracted from the skins, collected in a tub and allowed to settle and next morning transferred to a copper or iron pot and boiled. The scum formed is removed and the must continuously stirred. After boiling for about 3-4 hours the moskonfyt syrup is obtained. Preference is given to boiling in an open pot and the taste is also improved by adding fig leaves, cinnamon, etc.

Certain questions with reference to the sugar concentration have recently received attention as a result of the increase in production of moskonfyt on a commercial scale. Details are given of experiments made at Elsenburg Viticultural Station, and it is concluded that from 68-69% sugar gives the most satisfactory results. This corresponds to a boiling point of about 108 C. It has been proved that it is necessary to reduce acidity of the must to about 3-4.0 % before concentration, and a 75 % pure calcium carbonate is advised in preference to slaked lime, which imparts a bitter taste to the syrup. The custom of leaving the must to ferment slightly before boiling has been investigated. Crystallisation takes place more slowly, but the fermentation has probably a beneficial effect; further experiments will, however, be made.

The growing importance of this industry is now fully recognised.

M. L. Y.

[474-473]

476. Co-operative Grain Storehouses (Dock-Silos) in North Africa.

FURGIER, H. Les magasins à blé coopératifs dans l'Afrique du Nord. *Revue agricole de l'Afrique du Nord*. Year 21. No. 183, pp. 69-74. Algiers 1923.

In most of the cereal-growing districts of North Africa, the agriculturist has no store-houses for his grain, and the farms which are generally 25, 50, or even 100 km. distant from the railway, only possess inferior means of transport and bad roads that are impassable during winter. Therefore, he is obliged, in order to avoid risk of loss and to be able to realise in good time the sums he needs for the following agricultural season, to clear off and sell his crop as soon as it is harvested and before the cart-tracks and roads at his disposal become useless.

In this way, all the products of the same district are thrown on the market at once, so that the farmer is unable to safe-guard his interests at the time of sale, the clearing-stations are obstructed and the cereal-growers consequently suffer serious injury.

The only remedy for this unsatisfactory situation is the construction of co-operative wheat "docks", or store-houses, in all centres which have no means of housing or disposing of their grain. These store-houses would enable the producer to send away his crops as soon as they are carried, at which time (August, September) he has at his disposal every means of transport. Further, he could raise money on his grain in order to obtain the sums he requires and have the cereals sold when he considers the market most favourable.

These advantages did not escape the notice of the South African farmer, who as long ago as 1918, realised that the storing and clearing of his crops was of paramount importance.

We must not forget in this connection that after the harvest of 1918, many hundreds of thousands of quintals of wheat remained exposed to the winter storms as a result of lack of housing-room and means of transport, and were finally removed at great cost on the backs of thousands of dromedaries brought especially for the purpose from the south, where they had already been distributed, after spending the summer in the North.

As a result of these misfortunes, it was strongly urged that large store-houses should be constructed in Algeria, especially on the great grain-growing plain of Sersou, on the High Plateaux (average altitude 800 metres), where over one million quintals of wheat are annually produced.

This granary, which will have a capacity of 125 000 hectolitres (about 100 000 quintals of wheat) was begun in 1922 and will be finished in time to house the harvest of 1923. Like the American elevators, it is divided into two parts, the one intended for storing the grain consists of 100 silos each with a capacity of 1250 hectolitres, a side measurement of 2.50 m. and a height of 20 m. and the other part is specially arranged for the reception and storing of the grain, and houses the necessary machinery.

Reception. — The grain is brought by the producer either in sacks, or loose, and after threshing it is weighed, poured into a hopper, raised to the sorter (3rd floor) where it is all cleaned; on leaving the dresser, the weight of the clean seed is registered by an automatic weighing ma-

chine, the specific gravity of the grain is determined and the offal placed at the disposal of the consigner.

The grain is then raised to the upper transporter and poured into the right silo; it is stored loose, according to its quality which is estimated from the specific gravity.

Delivery. — The silos open at the bottom and discharge their contents on to a transporter that carries the grain to the receiving hopper; this grain is raised by an elevator to the bagger, put into sacks (on 1st floor) and graded. As the railway and high road are just below, the trucks, or lorries, can be loaded with the minimum amount of labour.

Standardisation. — The quality and specific gravity of the grain in each silo being known, it is easy, by regulating the opening of the various silos, to obtain a homogeneous mixture composed of grain of the same type, and uniform specific gravity which allows of standardisation being effected. In this manner large quantities of grain of uniform specific gravity will be able to be put on the market at once which will facilitate direct dealings with the flour mills, allow of better prices being obtained and tend to the suppression of middlemen. On the other hand, the Society of the Co-operative Granaries at Sersou which considers that the peasant should not speculate, arranges for the stored grain to be sold monthly in fractions of $\frac{1}{4}$, $\frac{1}{5}$ or $\frac{1}{6}$ during the 4, 5, or 6 months following the harvest. The money obtained is then divided according to the quantity and quality on consignment of the grain deposited by each farmer, all of the consigners thus profiting by the prices paid during the whole season.

Until these sales are effected, the agriculturist who finds himself short of money can obtain, on the security of his grain, any sums he may need which are readily advanced to him by the Banks of Mutual Agricultural Credit, or other Banking establishments.

The above are the chief regulations for the working of these storehouses. The capital necessary for their construction which has been fixed at 1 250 000 fr. (10 fr. per hectolitre stored) has been obtained as follows: 500 000 fr. paid immediately by the cooperative members (5 fr. per hectolitre of grain stored) 500 000 fr. from the grant made by the Colony and 250 000 fr. also from the Colony in the form of a long term loan.

The large sum which the Colony has thus placed at the disposal of the Co-operative storehouse-silos of Sersou shows the importance attributed by the Algerian Government to the formation of this Co-operative Society. We may consider that but for this assistance, the first storehouse with elevator would not yet have been built. For the construction of those to be built in future, if the budget permits, the Algerian Government intends as a general rule to pay one quarter of its contribution in the form of a grant and one half in the shape of a loan.

With such encouragement, there is no doubt that other similar storehouses will soon be built. So far, in addition to the Burdeau storehouse, another with a capacity of 10 000 quintals has been constructed at Brazza (Algiers) owing to the initiative and perseverance of M. RODET. Further storehouses, at Thiersville (50 000 quintals), Maalifs (25 000 quintals)

AGRICULTURAL INTELLIGENCE

Bel-Abbès (100 000 quintals), Relizane (100 000 quintals) and Inkermann (40 000 quintals) are under consideration, or are shortly to be built.

The "Société des Docks-silos coopératifs du Sersou", after making a careful study of the different storehouses for grain used in various countries, have come to the conclusion that the German "Kornhauser", though adapted to countries with small holdings, are not suitable for the storage of the large quantities of cereals grown on the High Plateaux of Algeria. It has therefore decided, to make the first grain storehouse of the type of the American elevator and provided with the latest and most improved apparatus for cleaning and sorting the grain.

E. P.

477. Characteristics of Italian Grape Pips.

L'industria degli oli e dei grassi, Caratteristiche dei vinaccioli italiani Year III, No. 2, p. 16. Milan, 1923.

As a result of the work of the Cattedre Ambulanti di Agricoltura. (Itinerant Agricultural Instruction) the "R. Stazione sperimentale Oli e Grassi di Milano" has collected 22 samples of grape pips from practically every part of Northern and Central Italy. Analyses have been made to ascertain the oil content (extracted by solvent or expressed) and the iodine value. The pips, air-dried, contain on an average 28.7% moisture and 33 % impurity. The oil content of crushed pips extracted with ethyl alcohol varied from 8.52 % to 17.52 %; average 14.4 %. There is also a marked difference in the yield including that of two samples from the Province of Modena. Two samples from Cagliari gave respectively 14.28 % and 12.65 %. The iodine value varied between 94 and 118; the amount of oil obtained by pressure was invariably somewhat lower than that obtained by solvent extraction.

F. D.

478. The Constituents of some Indian Essential Oils.

SIMONSEN, J. L. and RAU, M. G. *Indian Forest Records*, Vol. IX, Pt. IV, p. 36. Calcutta, 1922.

Results of a series of investigations with reference to the economic value of certain essential oils. Hitherto only the constants of the oils have been determined and no attempt made to isolate the actual constituents present.

The following oils were subjected to thorough examination:—

- 1) Oleo-resin of *Pinus Khasya*: yield 60 % crude rosin per maund (1 maund = 82 lb.); 1.6 gall. turpentine per maund.
- 2) Oleo-resin of *Pinus Excelsa*: yield 68 % crude resin; 2.5 gall. turpentine.

A comparison is made with the yield of rosin % in crude resin of *P. longifolia* viz. 70 %.

- 3) Essential Oil from *Cedrus Deodara* Loudon: the experiments seem to indicate that the commercial value of this oil is limited and that probably it would be more remunerative to distil the logs themselves and to use the crude wood oil as a timber preservative.

4) From *Andropogon Jawarancusa* Jones; comparative experiments with the oil from *Cymbopogon Sennarensis* Chiov from the Soudan seem to indicate their identity. The oil contains 45 % ketones (chiefly peperitone).

5) From seeds of *Zanthoxylum alatum*, Roxb. *T. Budrunga* Wall, and *Z. acanthopodium* D. C. — The two first appear to be of little commercial value. The last, however possesses a high linalol content and is of undoubted economic value.

M. L. Y.

479. Studies on Hemp Retting.

Rossi, G. *Annali della R. Scuola Superiore d'Agricoltura in Portici*, Vol. XVII. Portici, Della Torre, 1922.

Reference is made to several recent improvements in the methods employed for hemp retting and to new applications on a wide scale of practical importance. The following facts should be noted:

1) it is unnecessary to allow the current of air to continue for the entire period of retting as with flax, as 10 to 24 hours is sufficient;

2) the retting water can be utilised again with advantage (to the extent of $\frac{1}{3}$ old to $\frac{2}{3}$ new), adding the new culture to the constituents of the maceration;

3) it is probably advisable to separate the retted material by washing both for hemp and for flax;

4) sulpho-carbonic solution can be recommended for retting with aerobic pectic ferments, in a current of air.

In connection with this point, a description is given of several experiments made in 1920 in the Fünfkirche (Pecs; Baranya, S. Hungary) well-known for the Harkany springs, which are a source of carbon oxysulphide and are utilised in the hydro-therapeutic establishment on the premises. The carbon oxysulphide (COS) is uncommon and often confused with sulphuretted hydrogen (H_2S). Its origin is shown by the formula:



This solution is conducted to Drawazaboles (in the immediate neighbourhood of Drava) where it is used by the *Harkany* factory for the maceration of hemp which has been transported by the river.

Retting is carried out in 8 large tanks placed inside a closed hangar; into which the current of warm water is directed. Under normal condition retting with Drava water commences at a temperature of 35° C. but later the temperature falls according to surrounding conditions. Drying is carried out in the neighbouring fields near Decauville.

Nothing exceptional was noted when examined microscopically.

Two experiments were made which should be of practical commercial value; the first dealt with 100 qx. of unretted stems; the second with 150 qx. of flax straw. These were first mixed with Harkany water, brought to the required temperature and then after about 2 hours, the water was aerated, causing the greater part of the CO_2 and the COS to escape; 20 litres of culture *B. Comesi* were used.

Retting for unstripped stems requires 42 hours and for stripped hemp 60 hours, as note must be taken of the external low temperatures (which may fall to -5°C) with a consequent lowering of the temperature of the reservoir to 31°C in the first case and to 28°C in the second experiment.

The continuous washing of the material as practised in the establishment in question, gives excellent results.

The present studies include observations on the physiology and habits of the aerobic pectic microbe. The author claims, as a result of 20 years research that it may be concluded that a variability in type exists, but that it is possible to identify the old stock as *B. Comesii*, *B. kramerii* and *B. pecticus* and to distinguish them from other types isolated.

A descriptive comparison is made between 13 types, distinguished during 13 years' study, and the author confirms the hypothesis put forward in 1907 that *B. Comesii* includes a number of species. Mutations have occurred and an illustrated description of experiments is given, which indicate that the zymogens vary in activity with different cultures made under similar conditions.

After alluding to the resemblance which exists between other microbes the author considers that the pectic ferments may be applied also to *Asclepias* spp., *Sportium junceum* and to *Urtica* spp. but not to *Humulus Lupulus*.
G. R.

480. Cold Storage as an Aid to the Marketing of Plums.

OVERHOLSER, E. L. *College of Agriculture, Agricultural Experiment Station Berkeley, California, Bulletin No. 334*, pp. 427-463, tables 8. Berkeley, 1922.

The plum has not been regarded hitherto as a cold storage fruit. The investigations recently undertaken indicate, however, that certain varieties of California plums can be held in storage for 6-12 weeks and will retain their good dessert condition for some time.

The factors involved in the ripening of fruit are discussed. Records have been made of the respiration numbers (*i. e.* amount of carbon dioxide evolved by unit weight in a unit time), of several fruits, and this represents a measure of the rapidity of ripening. According to this the plum can be kept in cold storage for comparatively long periods of time.

Trials made at the Experiment Station, Berkeley, indicate that the most desirable temperature for storage appears to be 32°F , especially with late ripening varieties. For short storage, however, a temperature of 36°F has no marked influence; this point is of interest in shipping (*e. g.* varieties Kelsey, Wickson, French, Grand Duke and Satsuma kept for 5 weeks and were marketable 7-10 days later).

Observations made as to the degree of maturity for picking fruit for storage show that frequently shipping plums are picked too green. Fruit from the third picking made 4-10 days after the second proved better quality on ripening than from the first and second pickings, and stored with equally good results.

References to market prices indicate that storage of early plums is not profitable although this does not apply to mid-season and late varie-

ties. Of the varieties tested, the Kelsey, Grand Duke and Wickson kept longest and proved the most satisfactory. The author includes tabulated data for cold storage of 23 different varieties at 32° F (3 year's observations).

Attention is drawn to the precautions necessary in picking, grading, packing and handling fruit and reasons for failure in storage.

M. L. Y.

481. The Freezing Temperatures of some Fruit, Vegetables and Cut Flowers.

079 WRIGHT, R. C. and TAYLOR G. F. (Office of Horticultural and Pomological Investigations. Bureau of Plant Industry). *United States Department of Agriculture, Bulletin No. 1133*, pp. 1-8. Washington, D. C., 1923.

Determinations of the freezing points of a number of fruits and vegetables have been made by the Bureau of Plant Industry in compliance with the ever-increasing demands of trade and shipping.

Determinations were made as follows:

- 1) Apples: Average 28.48° F;
- 2) Bananas (green), peel 29.84°, pulp 30.22°; ripe peel 29.36° pulp 20.6°; blackberries 29.15°; cherries 27.81°; cranberries, 26.7°; currants 30.21°; gooseberries, 28.91°; grapefruit, 28.36°; grapes, 28.16°; loganberries 29.51°; oranges, 28.03°; peaches, 29.4°; pears (hard-ripe) 28.46°; soft ripe 27.83°; pecanmons, 28.33°; plums, 28.53°; raspberries, 30.41°; strawberries, 29.93° F.

Vegetables: Average for beans (snap) 29.74°; cabbage, 31.18°; carrots 29.57°; cauliflower, 30.08°; egg plant, 30.41°; Kohl rabi, 30.02°; lettuce, 31.2°; onions (dry) 30.09°; peas (green) 30.03°; potatoes 28.92°; sweet corn 28.95°; sweet potatoes, 28.44°; turnips, 30.23° F.

Cut flowers: Petals and leaves of lilies, peonies, and roses from 27° to 31° F.

M. L. Y.

Animal Products.

482. The Use of Morphological Phenomena in Research on the Watering of milk.

SPETELICI, L. (Head-Physician of the Saint Spiridon Hospitals, at Jassy, Rumania). *Phénomènes morphologiques dans les liquides organiques. Application à la constatation du mouillage du lait. Bulletin de la Société Scientifique d'hygiène alimentaire et d'alimentation rationnelle de l'homme*, Vol. X, No. 10, pp. 632-638, figs. 6. Paris, 1922.

The author has devised a new method to detect the watering of milk. The system is based on the facts that every organic liquid, according to its origin, exists under special physico-chemical conditions and that its morphological aspect, which is only the visible expression of these conditions, varies with the change taking place in them.

The indicator he used for the detection of added water in milk was a solution made by mixing about 23 drops of horse, or human, serum with

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a drop of good, liquid Chinese ink. A series of large drops of milk are dropped upon a sheet of glass, and one drop of the liquid indicator is placed in the centre of each. As soon as the indicator comes into contact with the milk, it takes on a different appearance according to the composition of the milk, thus enabling certain changes in the milk to be recognised. When the milk is skimmed, but not watered, the indicator floats on the surface of the drop; if the milk is adulterated by the addition of one-fourth of water, the indicator sinks into the drop, only leaving upon its surface a light trace of colour. In the first case, the reaction is said to be positive, while in the second, it is negative. The reaction of unadulterated skim milk whether it has been boiled, or not, is always positive, whereas watered skim milk before and after boiling, and pure boiled, or unboiled, unskimmed milk has a negative reaction. Therefore if milk is to be tested by the new method, the following system must be adopted. If the reaction is distinctly positive, it may be concluded that the milk is unadulterated, but has been skimmed; if, however, the reaction proves negative, a small quantity of the milk is centrifugated; a positive reaction obtained from this skimmed milk would show that it had not been watered, but a negative reaction would prove the milk to have been adulterated. Should the milk examined after centrifugation not give a distinctly negative reaction, this would prove the amount of water added to be below 25 %. If the reaction is uncertain, $\frac{1}{8}$ of water has been added to the milk sample, if the reaction then becomes distinctly negative, it can be safely assumed that the milk had been watered, if, however, the reaction still remains slightly positive, the milk tested was certainly quite pure. To be profitable, 25 % or even more of water must be added to the milk.

Watered milk to which starch, or sodium bicarbonate, has been added to mask the watering always has a negative reaction.

Milk that has been watered and then evaporated until all the added water is removed, and the serum of milk that has been completely skimmed after the casein has been separated by means of an acid, give a positive reaction. The author also studied the effect of the season, of the breed of cow, and the daily milk yield upon the morphological phenomena and found that they had no influence on the result. Many variations due to the origin of the milk are observable but these are of no importance.

It remains still to be determined how far the morphological characters vary with the proportion of water, casein, albumen, lactose and salts present, and to find the exact limits of the reaction when water has been added to the milk.

F. S.

483. Determination of the Specific Gravity of Fresh Milk.

BARKE, S. (Chimiste en chef des Usines Nestlé), and HONEGGER, P. *Le Lait*, Year 3, No. 1, pp. 3-10. Lyon, 1923.

The authors point out that the fixing of the specific gravity of milk has up to the present been arbitrary and that this weight can be affected

by causes other than age and temperature; for example, by transport conditions which can diminish the specific gravity of milk.

To restore the milk to its original specific gravity it must be placed in a bath of boiling water and gently stirred until it has reached the temperature of 40° C; the milk is then rapidly brought back to a temperature of 15° C and the specific gravity is determined.

The experiments have proved that this method is sufficient for all kinds of milk at all stages and whatever the temperature at which they have been preserved. F. S.

484. Estimation of the solid Fat-Free Substances in Cows Milk.

MASUROVSKY, B. (Dairy Husbandry Department, University of Lincoln, Nebraska), A Study of the determination of solids-not-fat in Cow's Milk. *Journal of Dairy Science*, Vol. VI, No. 2, pp. 145-149, table 1, figs. 1, bibliography. Baltimore, 1923.

The variability coefficients of the fat free solid matter content of cows' milk as determined by the Babcock formula are as follows: Jerseys; 0.9925; Holstein-Friesians: 0.9917; Ayrshires; 0.9955; Shorthorns: 0.9890; mixture of the milk of all these breeds: 0.9922.

On comparing the results obtained by the Babcock formula with those obtained by the gravimetric system, the author found an average deviation of 0.0604 in the case of the Babcock system.

The formula should therefore be corrected and stand thus:

$$\text{Solids not-fat} = \left(\frac{L}{4} + 0.2 f \right) 0.0604.$$

F. S.

485. The Uses and Synonyms of "Thionin".

CONN, H. J. (Department of Bacteriology, New York Experiment Station, Geneva, New York) Thionin. *Journal of Dairy Science*, Vol. VI, No 3, pp. 135-136, Baltimore 1923.

There are two kinds of thionin, one simply thionin (synonym Hauth's violet), and the other thionin blue. The former is used in the Frost method for counting and studying the bacteria in milk, while the latter, which is not suitable for these purposes, is the best known, being employed in dyeing. (Schultz's Farbstofftabellen). F. S.

486. Injurious Action of Light on Butter.

LAUTERWALD, F. Die Schädliche Einfluss des Lichtes auf die Qualität der Butter. *Molkereizeitung*, Year 37, No. 17, p. 309. Hildesheim, 1923.

Basing his remarks on personal experience in the capacity of "Molkerei-instruktor" (Instructor to the Dairy and Dairy Products Industry), the author lays stress on the strong action of light upon butter which is far more injurious than is stated by treatises on the subject, or believed by practical dairymen. Ten minutes exposure to brilliant sunshine is enough

to give a sebaceous appearance and flavour to the finest sample of butter. He therefore advises the following technique :— the butter must be worked as soon as it comes from the churn, salted, made up, and at once taken into the dairy (which must be dark, damp and well-ventilated) ; there it should be left to drip until the next day, again made up, put into barrels and the covers put on. The windows of the butter dairy must be red, yellow, or grey. The custom of exposing butter for sale in the shop-window should be abandoned, even if it is covered over to keep it dark. Also in the house, the butter should be kept in yellow, red, or grey glass vessels and never in green, blue or colourless receptacles. F. D.

487. The Air Content of Butter.

RAHN, O. and STORN, A. Die Luftgehalt der Butter. *Molkerei Zeitung*, Year 37, No. 23, p. 433. Hildesheim, 1923.

A high air content diminishes the keeping qualities and the delicacy of flavour of butter as the result of oxidation phenomena, the development of aerobic bacteria, etc. The authors determined the amount of air present in numerous samples of butter by means of an apparatus of their own invention. In the specimens shown at the Butter Exhibition held in 1922, in Schleswig Holstein, they found field-made butter to contain on an average 4.42 cc. of air per 100 gm. (max. 7.20 cc., min. 1.74 cc., while the figures obtained per 100 gm. of dairy-made butter were respectively 4.14 4.50 and 0.97 cc. In the case of 17 samples of butter sent to the Hamburg Butter Auktionen (sales by auction), the average maximum and minimum amount of air in 100 gm. of butter was 2.83-3.60 and 1.34 cc. The two series of results therefore agree fairly well. It is thus clear that the air content of different butters varies considerably; in the product of some farms it is particularly high, but generally speaking, field-made butter contains more air than dairy-made. F. D.

488. Effect of Oil of Mustard upon the Coagulating Power of Rennet.

DRUGÉ, M. F. (Expert chimiste, chimiste en chef de la maison Lefèvre-Utile, de Nantes). Influence de l'essence de moutarde sur le pouvoir coagulant de la présure. *Le Lait*, Year 2, No. 10, pp. 808-809. Lyons, 1921.

In order to determine the effect of mustard oil upon the coagulating power of rennet, DRUGÉ compared the time required for the coagulation of a control lot (milk and rennet) with the length of the coagulation process in the case of other lots to which mustard oil had been added in different proportions and under various conditions. These experiments showed that mustard oil has no effect whatever on the coagulating property of rennet. R. D.

489. Honey and Atmospheric Moisture.

WATERS, R. (Biological Laboratory Wellington), *The New Zealand Journal of Agriculture*, Vol. XXVI, No. 2, pp. 106-107. Wellington, 1923.

From the results of laboratory experiments the author concludes that in a dry atmosphere, the water content of honey rises with its increase in

specific gravity, whereas a lower specific gravity allows the water to escape more easily. On the other hand, when the atmosphere is saturated with moisture, honey with a higher specific gravity is able to absorb relatively more water in a given time than honey with a low specific gravity. In a saturated atmosphere, the samples used by the author were able to absorb water much more rapidly than they could yield it up in a dry atmosphere.

The author found on exposing honey to natural atmospheric conditions, but protecting it from the sun, that it slowly reaches a state of equilibrium as regards gain and loss of water, after which its moisture content varies with the changes in atmospheric moisture but in a lesser degree. These variations would, however, seem to be more perceptible as the temperature of the atmosphere rises.

By exposing the honey to the air only during the hours of sunshine, the author proved that the quality of honey depends upon temperature. In fact, at a temperature of 10° C. to 15° C. the specific gravity of a good honey decreases by 0.001 in 2 or 3 days, whereas when the temperature is from 15° to 26° C., the specific gravity of a honey of poor quality increases 0.001 every 8 or 9 hours.

F. S.

BIBLIOGRAPHICAL NOTES.

490. SCHMITTHENNER, F. Wein Entkeimung auf kaltem Wege durch Filtration. Ein Neues Verfahren zur Behandlung krankheitsgefährdeter Weine. (Freeing Wine from Microorganisms by Filtration). *Wein und Rebe*, Year 5, Part 1, pp. 3-12, figs. 2. Mentz, 1923.

Description of the E-K multiple disk-filter made by Messrs. SEITZ of Kreuznach (Rhine Province). This filter has pores less than 1 micron diameter and is able to free wine completely from all micro-organisms without the application of heat, or any alteration in the bouquet of the wine, which must, however, be clarified previously.

F. D.

491. CIFERRI, R. Risultati ottenuti in esperienze di relazione fra la fermentazione vinaria e i protozoi del terreno. (Correlation between Grape fermentation and Soil Protozoa). *Rivista di Ampelografia*, Year IV, No. 1, pp. 4-5. Alba, 1923.

Observations were made concerning: 1) the relation between protozoa found in the grape; 2) the subsequent effect on the rate of fermentation. It was noted amongst other things that the small proportion of Protozoa existing in the grape (independent of the variety, in the clean, healthy and uppermost grapes) are identical with soil protozoa and they in no way hinder or alter the fermentation process.

F. D.

492. WILSON, C. A. Exploitation of Nipah Palm in Malay, as a Sugar and Alcohol Source. *Sugar*, Vol. 25, No. 3, p. 130. New York, 1923.

Report of the new projects for the cultivation of Nipah palm, primarily for its alcohol producing qualities, and a comparison of the treat-

ments given in the manufacture of sugar in other countries. According to reliable statistics nipah supplies the cheapest alcohol known. M. L. Y.

493. EATON, B. J. and DENNETT, J. H. Report on Investigations on the Production of Alcohol from Nipah Palms (1) *The Malayan Agricultural Journal*, Vol. XI, No. 3, pp. 47-63, tables 4. Kuala Lumpur, 1923.

The authors supply information concerning areas reserved for Nipah palm in the Federated Malay States, followed by a report of investigations on: 1) Composition of sap, and changes which occur during and after collection; 2) methods of planting; 3) yields of sap and period of tapping 4) production of alcohol and sugar. M. L. Y.

494. WOODMAN, H. E., (Animal Nutrition Institute School of Agriculture, Cambridge University). The Chemistry of the Strength of Wheat Flour. *Journal of Agricultural Science*, Vol. XLII, No. 3, pp. 231-243, bibliography. Cambridge, 1922.

Investigations by comparative methods, of the gliadine and glutenine proteins from typical strong and weak flours. It is suggested that the strong wheat synthesises one type of glutenine and the weak wheat a different type, whilst wheats of intermediate strength may contain varying proportions of the two glutenines. L. V.

495. Dr. HANS GELLINGER, D. Experimentelle Beiträge zur Microbiologie der Getreidemöhle. *Travaux de Chimie alimentaire et d'hygiène Publiés par le Service fédéral (Suisse) de l'hygiène publique*, Vol. XIV, Pts. 1-2, p. 17 and Pt. 3, p. 115. Berne, 1923.

Research on *Coli* bacteria in wheat flour.

D. V. S.

496. LIPPMANN, Dr. E. C. Fortschritte der Rubenzucker Industrie, 1922. *Chemiker Zeitung*, Year 47, No. 13, pp. 89-91. Göttingen, 1923.

An account of the sugar beet industry in Germany, from the agricultural, technical and chemical standpoints. D. V. S.

497. PERIN, L. (ingénieur chimiste) Extraction de l'huile des graines oléagineuses par l'acétone. (Extraction of Oil from Oleaginous Seeds by means of Acetone). *L'Industrie chimique*, Year X, No 109, pp. 64-65, fig. 1. Paris, 1923.

498. SIMONSEN, J. L., and MADYAR GOPAL, RAU. (Forest Research Institute, Dehra Dun). The Constituents of Indian Turpentine from *Pinus longifolia*, Roxb. *Journal of the Chemical Society*, Vol. 123-124, No. 725, pp. 549-560. London, 1923 (see also 1920, 117 p. 570).

D. O. S.

(1) See R. Jan.-March 1923, No. 112. (Ed.)

499. ALLEN, W. J. Storage of Lemons, *The Agricultural Gazette of New South Wales*, Vol. XXXIV, Pt. 2, p. 127. Sydney, 1923.

Results of comparative tests with stored fruit: 1) dusted with slaked lime; 2) coated with vaseline; 3) dusted with sulphur; 4) wrapped without treatment. The Experiments were made at the Yanco Experiment Farm and at Hawkesbury Agricultural College. The liming treatment proved the most effective.
M. L. Y.

500. VIERA NOVO, A. As amendoas. *Broteria, Serie de Vulgarizaçao Scientifica*, Vol. III, Part I, pp. 10-16. Braga, 1923.

This article contains an account of almond growing and trade in the chief countries of production, and especially in Spain. Some information is also given respecting almond production in Portugal. The principal centre of this industry in the latter country is the Province of Algarve. In 1919, 784 459 kg. of unshelled almonds and 1 526 627 kg. of shelled almonds were exported from Portugal, as against 779 790 and 1 502 048 respectively in 1913. In years of greater production when the export trade is more active, almonds fetch higher prices.
F. D.

501. LEGENDRE, G. Le contrôle laitier et beurrier au pâturage en Normandie. Milk and Butter Tests made in the Pasture Districts of Normandy. *Revue de Zootechnie*, Year 2, No. 1, pp. 65-72, figs. 3. Paris, 1923.

After having described the constitution of the Milk Testing Associations that have been formed in the districts of Caux and of Bray, the author passes on to give an account of the work of the controller and the method of calculating the milk and butter production of cows subjected to these tests. The article also contains a reproduction of one of the certificates presented to the breeder for each of his tested cows at the end of every lactation period. It should be noticed that in the district of Caux, milk testing is not only carried out in the cow-shed, but also in the pasture.
F. S.

502. MACY, H. (Dairy Bacteriology Laboratory University of Minnesota, St. Paul, Minnesota). A Ropy Milk Organism isolated from the Finnish "Piima" or "Fiili". *Journal of Dairy Science*, Vol. VI, No. 2, pp. 127-130. Baltimore, 1923.

Description of a Finnish ropy-milk organism to which the author has given the name of *Streptococcus piima*.
F. S.

503. POZZI-ESCOT (Institut National d'Agriculture et de médecine vétérinaire, Idma, Peru). Procédé de numération rapide des éléments microbiens du lait, applicable au contrôle industriel. *Annales de Chimie Analytique et de Chimie appliquée*, Series 2, Vol. 5, No. 5, pp. 130-132. Paris, 1923.

Rapid method for counting of microbes in milk, applicable to commercial control.
D. V. S.

504. BOUSKA, F. W. (Superintendent of Manufacturing, Beatrice Creamery Company, Illinois). Acidity of Butter and its By-products. *Journal of Dairy Science*, Vol. VI, No. 2, pp. 112-226, figs. 2. Baltimore, 1923.

Practical hints for churning and for regulating the acidity of butter
F. S.

505. RHOADES, E. (Assistant Chief, Poultry Division, Live Stock Branch), Canadian Egg Standards. *The Agricultural Gazette of Canada*, Vol. X, No. 1, pp. 28-30. Ottawa, 1923.

Canada is at present the only country where egg-classification is based on external and internal characters. The eggs are graded according to weight, size of the air-space, transparency of the yolk, consistency of the white, and cleanliness. The author sets out the different rules for the classification of exported and imported eggs, and describes the manner in which egg marking is controlled.
F. S.

506. BALAVOINE, P. Sur la multirotation des miels. *Travaux de chimie alimentaire et d'hygiène, publiés par le Service fédéral Suisse de l'hygiène publique*, Vol. XIV, Pt. 3, p. 125. Berne, 1923.

Studies on the determination of the polarimetric value of natural honey.
D. V. S.

PLANT DISEASES.

Plant parasites.

507. Potato "Scab" (*Spongospora subterranea*) Reported in Algeria.

CHRESTIAN, J. Une nouvelle maladie des tubercules de pomme de terre en Algérie. *Revue Agricole de l'Afrique du Nord*, Year 21, No. 197, pp. 993-995, fig. 1; No. 198, pp. 310-312, figs. 2; No. 199, pp. 330-332. Algiers, 1923.

The presence of potato "scab" (*Spongospora subterranea*) has lately been discovered in Algeria.

Two hypotheses, both equally plausible, have been advanced to explain the origin of the disease in this Colony, viz., either favourable conditions have caused the myxomycete, which already existed in Algeria as a saprophyte, to become parasitic and to attack potatoes, or else, the pathogenetic agent has been introduced by means of imported tubers possibly of British origin.

The author does not believe that the "scab" will do any great harm to the Algerian crops. The yield of two fields of infected potatoes in the neighbourhood of Algiers, one at Guyotville, and the other at Fort-de-l'Eau, was relatively little reduced. At Guyotville, 60 kg. of potatoes were lost out of 22 quintals of tubers lifted, while at Fort-de-l'Eau, out of a crop of 660 kg., only 60 kg. were spoiled. In the first case, the loss amounted to $\frac{1}{10}$ and in the second to about $\frac{1}{36}$. These crops had been obtained from tubers of foreign origin (var. Royal Kidney) planted in December.

The external and internal symptoms of the disease are described by the author, as well as the factors favourable to its development and the means of control. G. T.

508. **Observations on the "Stripe Disease".**

PAINE, S. G. and MACEY, M. S. *The Annals of Applied Biology*, Vol. IX, Nos. 3-4. p. 210-212. London 1923.

The question has already been raised as to whether on further investigation, the "Grand Rapids Disease" might not prove to have a common etiology with the Stripe disease (1). Two organisms have been isolated from the "Grand Rapids Disease", viz. *Bacillus lathyri* and the yellow *Aplanobacter michiganense* E. F. Smith, which possess many properties in common. Recent investigations and inoculations have shown that the two diseases are quite distinct, and the yellow organism, *Aplanobacter simulans* n. sp. which is frequently found associated with *Bacillus lathyri* is not identical with *Aplanobacter michiganense*. G. B. T.

509. ***Fusarium* sp. *Colletotrichum phomoides*, *Phytophthora infestans* und *Tetranychus telarius* on the Tomato in Argentina.**

GIROLA, C. D. Enfermedades del tomate en Argentina. Podredumbre apical (*Fusarium* sp.), Antracnosis (*Colletotrichum phomoides* Sacc.) y peronospora (*Phytophthora infestans* De Bary). *Boletín del Ministerio de Agricultura de la Nación*, Vol. XXVII, No. 3, pp. 503-504, figs. 1, Buenos Ayres, 1922.

In February 1922, the fruits of tomato plants growing at Temperley F. C. S. were found to be suffering from two diseases "podredumbre apical" (apical rot, a malady never before reported from Argentina, but which the author is inclined to attribute to a species of *Fusarium*), and "anthracnosis" (*Colletotrichum phomoides* (Sacc.) Ches.). The leaves of the same plants also showed traces of "peronospora" (*Phytophthora infestans* De Bary), a fungus not hitherto observed on the tomato in the Republic, and of the presence of a mite, *Tetranychus telarius* L.

The author considers the simultaneous presence of these different parasites to be due to the prevalence of meteorological conditions that were specially favourable to their development.

Apical rot seems fairly diffused, for the author found *Fusarium* present on tomatoes coming from very distant places.

(1) See R. 1920, No. 700 (Ed.)

The most effective means of controlling the disease is to use only seed from healthy fruits selected from plants that have remained immune. Further, tomatoes should never be planted on soil that has been contaminated for several years. It is well to spray the plants with ordinary Bordeaux mixture; the treatment should be applied soon after the tomatoes are transplanted and must be repeated three or four times before the fruits begin to form. This prevents the appearance of "peronospora" and "anthrac-nosis" which predispose the tomatoes to apical rot.

All parts of the plant showing any trace of the disease ought at once to be cut off and burnt. It is a good plan to disinfect the sticks supporting diseased plants with a $\frac{1}{1000}$ solution of corrosive sublimate, or with formalin. G. T.

510. **Apple Canker (*Nectria galligena*) Infection through Scab Wounds.**

WILTSHIRE, S. P. (University of Bristol Agricultural and Horticultural Research Station, Long Ashton). *Annals of Applied Biology*, Vol. IX, Nos. 3-4, pp. 275-281, tables 1. London, 1922.

The author has referred in a previous paper to the fact that the canker fungus (*Nectria galligena* Bres.) can enter the apple tree through wounds caused by scab fungus *Venturia inaequalis*, and in this article describes this process in detail.

The scab fungus infects the shoots of apple trees during the autumn following their growth; in the spring most of the pustules are surrounded by a cork layer and are subsequently completely separated from the tree, the only trace of infection being a slight roughness of the bark, which facilitates the entry of the canker. If the tree is sufficiently vigorous to form a cork layer round such a scar before the wood has become infected, the canker makes very little progress, otherwise the fungus develops in the normal way.

A microscopic examination reveals the presence of two mycelia somewhat difficult to distinguish between, but generally speaking, that of the scab fungus appears dark and inclined to be thick walled, whilst that of the *Nectria* fungus is hyaline and thinner.

The penetration of *Nectria galligena* into the cortex is described in detail. During the summer the progress is slow, as was confirmed by observations.

As regards control measures, it seems that it is not only a question of protection of fruits, but also of the bark injured by the scab *Venturia*. Winter spraying, immediately after defoliation, has proved effective.

G. B. T.

Weeds and Parasitic Flowering Plants.

511. **South African Species of *Cuscuta*.**

YUNCKER, T. G. Revision of the South African Species of *Cuscuta*. *American Journal of Botany*, Vol. IX, No. 10, pp. 555-575; Vol. X, No. 1, pp. 1-17, tables 5, bibliography. Lancaster Pa. 1922-1923.

In a recent study, the author made an examination of a number of specimens of *Cuscuta* from South America, and has since made a thorough

revision, based on the examination of a several collections in herbariums in various parts of the United States. This article includes a description and key to the species known to occur in South America and the Galapagos Islands, comprising 38 species, seven of which are new to science viz.:— *C. brevisquamata* (Argentina); *C. argentinana* (Argentina); *C. boliviana* (Bolivia); *C. goyaziana* (Brazil); *C. serrata* (Brazil); *C. orbiculata* (Brazil); *C. insquamata* (Bolivia).

For all the species mentioned, the distribution in South America is indicated and reference is also made in this monograph to the North-American species. The host plants are not given. G. B. T.

Animal parasites.

512. **New Coleoptera Injurious to Different Plants in India and Brazil.**

BRVANT G. E. New Injurious Phytophaga from India and Brazil. *Bulletin of Entomological Research*, Vol. XIII, Part 3, pp. 261-265, figs. 4. London, 1923.

This paper gives a description of the following beetles:

- 1) *Bromiodes squamosus* n. sp. (fam. *Eumolpidae*), collected at Simla (India), where it was found attacking the young leaves of pear-trees in an orchard;
- 2) *Brevicolaspis villosa* n. sp. (fam. *Eumolpidae*), found in Bahia (S. Brazil), where it attacks the coco-palm;
- 3) *Metachroma rosae* n. sp. (fam. *Eumolpidae*), collected from rose-tree leaves, at Manchester (Jamaica);
- 4) *Zomba gossypii* n. g. and n. sp. (fam. *Halticidae*), collected at Luchenza (Nyasaland), and at Livingstone (N. W. Rhodesia), where it injures the cotton-plant; the new genus *Zomba* belongs to the sub-family *Monoplatinae* and is closely related to the genus *Glenidion* Clark, of South America. G. B. T.

513. ***Chrysomphalus paulistus* and *Chrys. dictyospermi*, Coccidae injurious to various plants, observed for the first time in Uruguay.**

TRUSILLO, PELUFFO, A. Dos nuevos coccidos para el Uruguay: *Chrysomphalus paulistus* Hemp. *Chrys. dictyospermi* Morg. *República Oriental del Uruguay, Ministerio de Industrias, Defensa Agrícola, Boletín Mensual*, Year III, No. 4, pp. 48-50, figs. 6. Montevideo, 1922.

Leaves of *Ligustrum japonicum* and of *Prunus cerasus* examined in March 1922 in the Laboratory "Defensa Agrícola" at Montevideo, were found to be attacked respectively by *Chrysomphalus paulistus* Hemp. and by "bianca rossa degli agrumi" (*Chrys. dictyospermi* Morg.), new Coccidae to Uruguay.

Chrys. paulistus has since been observed on leaves of *Laurus nobilis* and *Chrys. dictyospermi* on leaves of *Kentia*.

Hitherto the only species of *Chrysomphalus* reported in Uruguay was *Chrys. aonidium* L. as a parasite on leaves and fruit of *Citrus* spp. This is

widespread in Montevideo and will do much damage if control measures are not adopted.

A brief description is given of the chief characteristics of *Chrys. paulistus* and of *Chrys. dictyospermi*. G. T.

514. The "Argentine Ant" (*Iridomyrmex humilis*) Reported in the Territory of Valencia (Spain) (2).

FONT DE MORA, R. Sobre la presencia de la hormiga argentina (*Iridomyrmex humilis* Mayr.) en Valencia. *Boletín de la Real Sociedad Española de Historia Natural*, Vol. XXIII, No. 2, pp. 77-78. Madrid, 1923.

The "Argentine ant" (*Iridomyrmex humilis* Mayr.), which recently made its appearance on some orange-trees in the neighbourhood of Valencia, has already become very common in the orange-groves of Valencia itself and is not infrequently found in the gardens and nurseries.

According to observations made hitherto, the presence of the Formicide, encourages the propagation of the scale-insects (*Dactylopius citri* Risso), (*Pseudococcus citri* [Risso] Fern.), *Lecanium hesperidum* (L.) Burm. *Saissetia oleae* (Bern), *L. oleae* (Bern) Walk.) and *Icerya purchasi* Mask. *I. humilis* does not, however, do any direct injury by attacking floral buds and flowers. The insect has even been found in some dwellings in the territory of Valencia.

Satisfactory results in the control of the pest have been obtained by sprinkling the colonies with alcohol and benzine. Experiments are at present being made with arsenical mixtures, solutions of lysol and polysulphides of calcium.

Of the various formulae for preparing a viscous substance suitable for banding the trees to prevent the ascent of the "Argentine ant," the following have proved the best, although they are not entirely satisfactory:—

1) Resin	2 kg
Castor oil	1500 litres
2) Tallow	0.5 kg
Fish-oil	1 litre
Powdered resin	1 kg

G. T.

515. A Study of the Life-History of the Onion Fly (*Hylemya antiqua*), in England.

SMITH, K. M. *The Annals of Applied Biology*, Vol. IX, Nos. 3-4, pp. 173-183, 2 tables. London, 1922.

The Onion-fly (*Hylemyia antiqua* Meig. = *Phorbia cepetorum* Meade etc.), has become very wide-spread of late years in some districts of England, and

(1) See R. 1922, No. 873. (Ed.)

especially in Lancashire and Cheshire, where it does considerable injury to the crops of onions, and to the trade in these vegetables.

The eggs of the onion-fly are white and 1 mm. in length, and very closely resemble the eggs of *Chortophila brassica*. They normally hatch in three days but if the temperature is not very favourable, the larvae sometimes do not emerge for 6 or 7 days. The grubs make their way through the soil and perforate the onion-bulb. When full-grown, they are 9-10 mm. long and 1 ½ mm. broad in the widest posterior portion. These larvae are white, their hind extremity is truncated and bears tubercles, while the anterior end is pointed and provided with two chitinous jaws. The larval period lasts from 18 to 27 days, the average being 20, in young onions, although it may be protracted for 4 to 5 weeks in old bulbs from the year before, that have been put into the ground to propagate themselves. The larval period of the later generations which do not hatch out until the onions are larger and more mature, is longer than that of the earlier generations.

On attaining its complete development, the larva leaves the onion and pupates in the soil but remains within a short distance from the bulb. It assumes a dark-brown colour and its length is reduced to 6-7 mm., although the larval structure remains fairly distinct. The nymph stage lasts, on an average, 17 days.

The adult insect somewhat resembles the house-fly, but is of a lighter grey. It is about 6 mm. long and bears thick bristles, arranged more or less in four longitudinal rows, on the thoracic region. The male and female insects are much alike, though the female is distinguished by having eyes wider-apart and a lighter colour, while the abdomen is broader and pointed at the distal end owing to the presence of the oviopositor. The author was not able to estimate exactly the duration of the life of the adult insect under natural conditions; in the laboratory, it varies from three weeks to two months. According to observations conducted in the field and in the laboratory, there are three generations in the year which make their appearance between the end of May and the beginning of October. The third generation usually passes the winter in a pupal condition.

Onions are the ordinary food of this fly, although it has occasionally been known to attack leeks and shallots, and is sometimes found even on tulips.

The injuries caused by the insect are especially serious in spring when the onion seedlings have just come up; frequently all the young plants are destroyed. If the onions have had time to develop, the plants grow yellow and turn black, while the bulb, which may harbour from 3 or 4 up to 25 or 30 of the *Hylemyia* larvae, becomes a semi-liquid, rotten mass.

The eggs are laid in groups of 6 to 30 on the leaf sheaths, occasionally, they are deposited on the ground. The most important parasites of the onion-fly are a braconid hymenopteron, *Aphacreta cephalotes*, and a Staphylinid coleopteron, *Aleochara bilineata*.

G. B. T.

[515]

516. **An Attempt to Introduce Scoliid Hymenoptera from Madagascar into of Mauritius.**

D'EMMERÉZ DE CHAIRMOT, D. *Bulletin of Entomological Research*, Vol. XII, part 3, pp. 245-254, tables 4. London, 1923.

The parasitism of hymenoptera of the genus *Scolia* on the larvae of large beetles (gen. *Oryctes*) was discovered as early as 1840-1841 in Italy by PASSERINI, and in 1854, in Madagascar, by CONQUEREL. More recently, FABRE discovered species of *Scolia* parasitic on *Celonia* and *Anoxia*, while other similar cases have been recorded by different entomologists which show that the parasitism of these scoliids is generally not strictly specialised since the same species of hymenoptera may attack different species, or even genera, of host, while one host may harbour several species of these pests at the same time. This discovery is of practical importance, as it facilitates the introduction into any given country of foreign species of Scoliids in order to use them in the biological control of injurious Coleoptera.

In 1916, an attempt was made to introduce from the Barbadoes into Mauritius, *Tiphia parallela* for the control of *Phytalus smithi*, but the experiment had to be given up on account of difficulties due to the War. In 1917, the author made an attempt to introduce into Mauritius from Madagascar, *Scolia oryctophaga*, the natural enemy of *Oryctes* *simier*, in order to see whether it would prove of great utility in the biological control of *O. tarandus* which is injurious to the sugar-cane crop.

In this account of his experiment, the author gives the results of his work in Madagascar between June and August which induced him to catch various species of Scoliids. He treats exhaustively of their greater, or less, diffusion according to the presence of certain plants which are favourites with the adult insect, and states that this preference could be utilised for the purpose of concentrating on a given area, large numbers of Scoliids and other insects.

The author then describes the method of transporting captured individuals of *S. oryctophaga*, and gives an account of the laboratory experiments which enabled him to determine that this species can be successfully used for parasiting *C. tarandus*. He also gives the biological observations he made, together with a detailed description of the various developmental stages of the parasite, and appends some observations respecting the other species of Scoliids found in Madagascar and Mauritius. He concludes by saying that although the experiment was not wholly satisfactory, its results did not prove entirely negative, so that it will be well to import more of these insects at the right season.

G. B. T.

517. ***Tetrastichodes platanellus* n. sp. and *Coccidencyrtus poutiersi* n. sp. Hymenoptera parasites of the Microlepidopteron *Lithocolletis platani* and on Cochineal *Howardia zamiae* respectively in France.**

GARCIA MERCET, R. Calcidoideos nuevos de Francia. *Boletín de la Real*

Sociedad Española de Historia Natural, Vol. XXXII, No. 9, pp. 596-602, figs. 4. Madrid, 1922.

Description of two new species of Hymenoptera observed in Mentone (France): *Tetrastichodes platanellus*, parasitic on *Lithocolletis platani* and *Coccidencyrtus poutiersi* parasitic on *Howardia zamiae* found on *Cycus revoluta*.
G. T.

518. *Phytodictus fumiferana* a New Hymenoptera Parasite of the Spruce Budworm *Tortrix fumiferana*, in British Columbia.

ROHWER, S. A. *The Canadian Entomologist*, Vol. LIV, No. 7, pp. 155-156. Orillia, 1922.

Description of the Hymenopteron *Phytodictus fumiferana* n. sp. reared as a parasite of the Microlepidopteron *Tortrix fumiferana* Clemens ("spruce budworm"), collected in July 1919 at Lillooet, British Columbia.
G. T.

519. The Olive Fly (*Dacus oleae*) and its Parasites in Morocco.

Communication officielle de la Direction générale de l'Agriculture, du Commerce et de la Colonisation du Maroc à l'Institut international d'Agriculture.

Investigations on the control of the olive fly (*Dacus oleae*) and its parasites made at the Laboratoire de Phytopathologie et d'Entomologie appliquée de l'Institut Scientifique Chérifien; these observations have already served a useful purpose in the olive districts of Marrakech.

It appears that the eggs of *Dacus* are laid at varying periods. The *Opus concolor*, parasite of the olive fly has been found in Morocco and eggs have been obtained in the laboratory. It is not improbable that this valuable parasite develops normally in Morocco.

Observations made by the Inspector of Agriculture at Marrakech seem to indicate that in this district the evolution of *Dacus* does not correspond with that reported in several other countries. The late appearance of the parasite, in mid-November and the rapid spread of the attack apparently excludes the possibility of successive generations during the summer.

In addition to this, the beginning of the attack seems to coincide with the first rains and it has been noted that the attack is more virulent when the catch crops require a large amount of water. From the fruiting season until mid-December, the majority of larvae have left the fruit to burrow beneath the soil. This active larva, although sparsely equipped, ought to search for a shelter in which to pupate, but the soil in this area, when it has not been broken up, is extremely resistant to penetration by larvae, which are finally destroyed. The excessive heat of Marrakech during summer, may have a deleterious effect on the vitality of *Daucus*.

It has been concluded that if these facts are subsequently confirmed, it should be possible to adopt certain cultural methods which will hinder the development of *Dacus*, limiting to a marked degree the damage caused by this parasite.

G. T.

[518-519]

520. **A Means of Freeing Fungus Cultures from Mites.**

JEWSON SIBYL, T. and TATTERSFIELD, F. *The Annals of Applied Biology*, Vol. IX, Nos. 3-4, pp. 213-240, figs. 3. London, 1922.

The infestation of pure fungus cultures by mites in bacteriological laboratories is the cause of such frequent and serious trouble, that it was worth while trying to find the best means of eliminating these intruders.

The authors' work at the Rothamsted Experiment Station has so far proved *Aleurobium farina* to be the commonest and most injurious species, although in some cultures, *Tyroglyphus longior* and *Glyciphagus cada-verum* are also present.

Experiments were carried out with different volatile organic compounds, ammonia, pyridine, aniline, monomethylaniline, dimethylaniline, benzene, toluene, naphthalene, paradichlorobenzene, carbon tetrachloride and carbon bisulphide, particular attention being given to the first two. Ammonia has a very rapid toxic action upon mites, but as the fungi also are affected, it cannot be employed for the elimination of acarids from the fungus cultures, although it is very useful in destroying the mites present in laboratory apparatus and Petri dishes. etc. On the other hand, pyridine, whether pure or commercial, if applied in the right concentrations, kills the mites without perceptibly injuring the fungi which can be transplanted into new cultures that remain immune.

The authors give a minute description of the action of ammonia and pyridine upon both mites and fungi, and in conclusion, describe the best and simplest way to disinfect the cultures.

A soup-plate containing about 20 cc. of commercial pyridine is covered with gauze and placed under a bell-jar having a capacity of about 20 litres. The test-tube of mite-infested cultures is placed, without removing the plug of cotton-wool, in the bell-jar, of which the mouth is closed with a sheet of glass fixed, with mastic or plasticine, and left there for 16 hours. If the infestation is very severe, the treatment must be prolonged for 40 hours, or repeated at intervals of 14-16 days to allow those eggs to hatch out that were not killed by the first treatment.

G. B. T.

521. ***Pachynematus clitellus* and *Dolerus hæmatodis*, Leaf-Eating Sawflies on Cereals in Great Britain.**

ROEBUCK, A., *Bulletin of Entomological Research*, Vol. VIII, Pt. 3, pp. 267-269, figs. 3. London, 1923.

Each season since 1918 numbers of leaf-feeding sawfly larvae, fam. Tenthredinidae have been seen in both oat and wheat crops, especially along the edges of the blades and on the upper portion of the leaves.

Two species have been identified as causing the damage: *Pachynematus clitellus* Lep. and *Dolerus hæmatodis*, species of which have been recorded in America as attacking cereals. The larvae disappear from the fields during the latter half of July and pupate in the ground. The

emergence of the sawflies takes place in the laboratory or in the field during the first half of May.

Oviposition of the female *Dolerus* was found to be produced parthenogenetically, the eggs being deposited on the leaf margin in varying numbers, the maximum, 15 per leaf; the young larvae hatched after 3-4 days. No observations have been possible as regards oviposition of *Pach. clitellus* as the larvae died too quickly in the laboratory.

In addition to wheat and oats, other species of Gramineae, Juncaceae and Cariceae have been attacked. Although the damage is not serious, the author calls attention to the fact that this species has appeared regularly during five seasons in different fields in the Newport district.

G. B. T.

522. **Potato Moth (*Phthorimaea operculella*) in the Belgian Congo (1).**

Ghesquière, J. La teigne de la pomme de terre au Congo belge. *Annales de Gembloux*, Year 29, Pt. 2, pp. 38-43, tables 1. Brussels, 1923.

The potato moth (*Phthorimaea operculella* Zell), has been reported to have done considerable damage to the Solanaceae in Katanga and was introduced into the Belgian Congo with seed tubers coming from South Africa. Up till now the Microlepidopteron has not been observed in the other three provinces of the Congo nor in the surrounding foreign territory.

For several years the damage done passed unnoticed and was of minor importance, but in 1919 the area attacked by potato moth was fairly extensive. In certain fields the losses were reported as 90% of the total yield and in some cases it was difficult to obtain healthy seed tubers; the losses have been noted earlier in the Upper Luapula territory.

The serious nature of the attack, the spread and the importance generally vary according to district, due largely to the Microlepidoptera as natural enemies. A Braconid has been reared by artificial means; the larvae which appears to be widespread, has been found living on the caterpillars and chrysalis of *Phth. operculella*, and the mite *Pediculoides ventricosus*, fairly common in the Congo.

A description is given of the different stages, with details as to habits and means of control found successful in combating this pest.

G. T.

523. **Mycetophilid Flies, Family *Sciaridæ*, as Pests of the Cucumber Plant in Glass Houses in England.**

Speyer, F. R., *Bulletin of Entomological Research*, Vol. XIII, Pt. 3, pp. 255-259, figs. 8, tables 1. London, 1923.

In January 1922, serious damage to cucumber pot plants under glass in Enfield was reported and found to be caused by larvae of *Pnyxia* (*Epidapus*) *scabiei*, Hopk, minute flies belonging to the family Sciaridae, which feed on the roots. Similar cases were observed elsewhere.

(1) See R. 1922, nos. 331, and 351. (Ed.)

It is probable that the flies have been prevalent in glass houses in preceding years, but that the damage caused has been attributed to eelworm.

The plants examined were potted out from the seedboxes in the middle of December. Attacks were first noted on January 8th and within 5 days, 600 plants were destroyed. The tap root of the infected plants had been eaten by the larvae and hollowed out below the soil surface; some roots contained as many as 60 larvae. On no part of the plant were any eggs found as oviposition takes place only in the soil and apart from the root stem. The full-fed larvae ate their way out of the stem below ground and pupated after a few days.

Another similar species, namely *Plastosciera pernicioso*, has caused serious damage to cucumbers under glass in the Worthing district and at Dartford. The larvae reduce the tap root to pulp, and cause further damage by removing the cortex of the stem just below and sometimes even above the soil surface.

As regards control measures, the following chemicals have been used with a view to killing the larvae: potassium sulphide; ammonium carbonate + copper sulphate; mustard; calcium chloride; ammonium carbonate; nitric acid; hydrochloric acid; potassium bichromate; potassium permanganate; ammonia. Except hydrochloric acid, which is injurious to plants, none of these gave any appreciable result. During the experiments, however, it was found that the larvae are susceptible to moisture conditions and reproduction can to a certain extent be regulated by watering the soil. For example, larvae immersed in water were found to be dead in about an hour. To destroy the larvae in pot plants, immersion for 12 hours or well watering each day is a satisfactory control measure.

G. B. T.

524. *Araeceros fasciculatus*: Coleopteron injurious to Coffee in Colombia.

Un gorgulho que ataca os cafezaes. *A Gazeta da Bolsa*, Year VI, No. 3, pp. 6-7. Rio de Janeiro, 1923.

According to the report of Prof. KOHLDOFF, received by the Brazilian Government, Ministry of Public Affairs, the coffee crop in Columbia has suffered from the attacks of the Coleopteron, *Araeceros fasciculatus* (1).

A brief description is given of this insect and its life history; treatment with heat and carbon bisulphide is considered effective, combined with thorough cleansing and repeated disinfection of the coffee stores where the Coleopteron has been previously observed.

G. T.

525. *Clastoptera theobromæ*, a Froghopper damaging Cacao in Panama.

WILLIAMS, C. B., *Bulletin of Entomological Research*, Vol XIII, Pt 3, pp. 271-274, figs. 3, tables 1. London, 1923.

During a search for parasites of Cercopidae in Central America in 1916-17 the author observed a frog hopper of the genus *Clastoptera* destroying

(1) See: R. 1917, No. 1259 and R. 1918, No. 1438. (Ed.)

the flowers of cacao in various localities in Panama. This is considered to be a new species, *Clastoptera theobromae* conspicuous for the masses of semiliquid froth which it leaves on the flower stalks of the cacao: each of these froth-masses contains from one to four or five nymphs, which suck the flower stalk and cause its death. Occasionally the froth occurs on other parts of the plant but never on the leaf petioles. In the froth the author found a number of larvae of a *Drosophilid*, thought to be uninjurious to the nymphs, but which probably are parasitic; observations made later on *Dros. paradoxa* found in the froth of *Clas. taeniata* in Trinidad support this hypothesis.

In addition to Panama, *Clas. theobromae* has been found in Costa Rica and seems also to exist in Ecuador.

G. B. T

526. **A New Phytophagous Chalcid attacking Bamboo (*Harmolita asquidens*).**

WATERSTON, J. *Bulletin of Entomological Research*, Vol. VIII, Pt. 3, pp. 307-310 figs. 2. London, 1923.

Description of the new species *Harmolita asquidens* which resembles the *Harm. phyllostachytis* described recently by A. B. GAHAN in California, but the new species was reared from larvae tunnelling in bamboo stems in Kuala Lumpur (Federated Malay States).

G. B. T.

527. ***Papilio cornetii*, a Macrolepidopteron destructive to Fruit in New Caledonia.**

PALADINI, F. (Senior). La lutte méthodique contre les fléaux calédoniens. Un fléau dans le Nord de la Nouvelle-Calédonie. Un papillon de nuit, destructeur de fruits (*Papilio cornetii*). *Revue agricole*, No. 84, p. 10. Numea, 1922.

A Macrolepidopteron called by the author *Papilio cornetii* — no description of the species being here given — does serious damage to all kinds of fruit in the north of New Caledonia where it has been known since 1876.

The insect only makes its appearance at the fruit-ripening season, viz., from November to the end of May, and can hardly be discovered during the rest of the year. It remains invisible all day on the fruit trees, but carries out its destructive work from nightfall until daybreak. The harm done by this parasite is greatest in seasons when the weather is especially mild and damp.

Once a fruit has been attacked by this Macrolepidopteron, it decomposes with surprising rapidity (in the course of one, or two, days). In 1922, similar to preceding years, the heavily-laden orange and mandarin trees were completely stripped of their fruit in two or three days as a result of the attacks of the parasite. The same may be said in the cases of peach and mango-trees, vines, *Nephelium Lit-chi*, etc.

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According to one observer, the insect entirely devoured the pulp of a banana in a single night having found its way to the fruit through a hole in the sack.

There have been repeated cases of illness, one of which terminated fatally, amongst persons who have eaten fruit attacked by *Papilio cornettii*.
G. T.

528. Scale Insects injurious to Citrus Trees in Argentina.

BLANCHARD, E. E. Principales cochinillas de los citrus en Argentina. Primera parte: Coccidos protegidos *Boletín del Ministerio de Agricultura de la Nación*, Vol. XXVII, No. 3, pp. 387-398, fig., table. Buenos Ayres, 1922.

Scale insects are some of the most destructive pests of the citrus trees in Argentina.

Firstly, the author deals solely with scale insects having their bodies protected by a shield. After a short account of their life-history, a description is given of the five chief species parasitic on citrus-trees in the Republic.

- 1) *Chrysomphalus dictyospermi* (Morg.) Leon ("cochinilla roja", "piojo rojo").
- 2) *Chrys. aonidum* (L.) popularly known as "cochinilla negra circular".
- 3) *Lepidosaphus beckii* (Newm.) popularly called "coma de los citrus" or "serpeta".
- 4) *Chionaspis citri* Comst. ("cochinilla blanca de los citrus").
- 5) *Aspidiotus hederae* (Vall), generally known by the name of "cochinilla blanca del olivo".

Of the fungus parasites of the scale-insects, one representative of the gen. *Myriangium* is very common in the damp parts of Argentina.

The beetle, *Coccidophilus citricola* Brths. occurs throughout nearly the whole Republic, it is one of the most formidable parasites of *L. beckii*. The hymenopteron, *Aspidiotiphagus citrinus* Hew., is a common endophagous parasite of *A. hederae*.

The scale insects are also kept in check by various artificial means.
G. T.

BIBLIOGRAPHICAL NOTES.

529. FEYTAUD, J. Le Doryphore, Chrysomèle nuisible à la pomme de terre (*Leptinotarsa decemlineata* Say). *Revue de Zoologie agricole et appliquée*, Year 21, No. 8, pp. 121-136, figs. 7; No. 8, pp. 137-158, figs. 5; No. 10, pp. 153-166, figs. 1. Bordeaux, 1922.

As a result of prevalence of the Colorado potato beetle (*Leptinotarsa decemlineata*) in the Gironde (France) (1) the author (Director of the Entomological Station at Bordeaux) has considered it important to bring before the public notice certain facts concerning this harmful American beetle.

(1) See R. 1922, No. 897. (Ed.)

The subject is treated under the following headings: — Description of the beetle; life history; conditions favourable or otherwise to reproduction; distribution in America, in Europe, in the Gironde; means of control.

Legislative and Administrative Measures adopted in connection with this pest from 15 July, 1878 to 27 July, 1922 are included (pp. 150, 152, 166, 168 *Revue de Zoologie agricole et appliquée*). (1). G. T.

530. STOREY, G. Recent Work on the Pink Bollworm. *Cairo Scientific Journal*, Vol. XI, No. 108, pp. 15-20. Cairo, 1923.

A brief review of recent information with regard to the Pink Bollworm; reference is made to the countries affected, alternative food plants, natural enemies and methods of control. G. T.

(1) See R., 1922, No. 897. (Ed.)

CURRENT NOTICES

Legislative and Administrative Measures.

Bavarian Law relating to the Examination of Stallions submitted for approval. (July 10, 1922). — No stallions can be licensed for public use that have not been approved by the examining commission ("Körasschuss") of which the composition and work are regulated by the above law. The latter is accompanied by a decree dealing with: 1) Breeding Stations; 2) the management of such Stations; 3) Stud Stations; 4) prizes for foals bred; 5) passing stallions; 6) stallions in service; 7) Breeders. Associations; 8) Advisory Board for Horse Breeders. (*International Institute of Agriculture, Bureau of Agricultural Legislation, Textes législatifs de l'année 1922, No. 34*).

United States Law forbidding Operations in Grain Futures. (September 21, 1922). — In order to prevent speculation in the cereal trade between the various States of the Union, this law forbids the transmission by post, or, in trading between the several States, by telegraph, telephone, wireless telegraphy, or any other means, of communications dealing with the making, or confirming, of any contract for the purchase of grain futures, or giving information as to the state of the market and the prices quoted for such transactions. (*Ibidem, No. 33*).

Decree respecting the Control of the Colorado Beetle of Potatoes in France. — The *Journal officiel de la République française* (No. 57 under date of February 27, 1923) has published the decree of February 13, 1923 which contains the regulations of the authorities for the application of the law of July 13, 1878, amended by the law of July 13, 1922, dealing with the measures to be adopted for the control of the Potato Colorado Beetle. (*International Institute of Agriculture, Bureau of Agricultural Legislation, Textes législatifs de l'année 1923, No. 1. See also R. 1923, p. 250*).

French Law relating to the Amendment of the Regulation applying to Distilleries. (February 2, 1923). — It deals with the notification of the substance distilled; taxes the distillation of alcohol in private houses, or in public establishments.

French Law referring to Stallions. (March 8, 1923). — Introduce amendments into the law of August 14, 1885 regarding the examination of stallions. (*Journal d'Agriculture pratique, April 14, 1923*).

Decree for the Pomological Station of Caen (France). (March 20, 1923). — Gives the terms under which the Caen Pomological Station and of the Tours Departmental Laboratory are entrusted with the analysis of samples of beverages, foods and agricultural produce, and extends the mandates of the Municipal Laboratories of Rouen, Rennes and Mans. (*Journal officiel de la République française*, March 24, 1923).

Law respecting Agricultural Taxes in France. (March 30, 1923). — This law fixes, for the year 1923, the maximum and minimum coefficients applicable, according to the crop, to the renting value of the land, to serve as a basis for the taxation of agricultural profits. (*Journal d'Agriculture pratique*, June 9, 1923).

Order of the French Minister of Finance respecting the Exportation of Walnut Wood. (May 29, 1923). — An Order of March 11, 1922 had authorised the free exportation of walnut and oak wood whether squared, or sawn. The Order of May 29 introduces amendments as regards walnut-wood of which it prohibits the export. (*Journal d'Agriculture pratique*, June 9, 1923).

Law for Renting the Alsatian Potash-Mines. — The French Chamber of Deputies has approved a bill dealing with the leasing of the potash mines in Alsace. The capital of the Society that has rented these mines is distributed between 6 groups, 50 % of the shares being reserved for the agriculturists as represented by their Associations. It has been decided with the consent of the Ministry of Agriculture, that the "Office national du Crédit agricole" shall have the prior right of acquiring (to the number determined by its Administrative Council) any shares that could not be subscribed for by the groups provided for by the constitution of the Society.

This Office may only dispose of any shares it acquires in favour of the whole agricultural group. The greatest precautions have also been taken to prevent the transference of the agricultural shares to any of the other groups. A sale-office shall be instituted of which the leasing Society and all the present, or future, managers of the potash mines must be members. This office shall have the exclusive right of selling in every country all the produce of the potash mines. The sale price in France shall not exceed the sale price in other countries unless special concessions are granted by the Higher Council of Agriculture, or the Higher Council of Mines. (*L'Industrie chimique*, Year 10, No. 110, pp. 114-115, Paris, 1923).

Official Documents Dealing with the French Colonies and Protectorates. Tunisia. — Decree relating to the free admission of olive-oil, olive-pomace oil and potatoes of Tunisian origin. (*Journal officiel de la République française*, February 9, 1923).

Morocco. — Decree of the Grand Vizier instituting, for 1923, a prize for the encouragement of planting, or grafting, olive-trees and carob-trees, and setting forth the conditions under which the prize is to be awarded. (*Bulletin officiel du Maroc*, January 30, 1923).

Coast of French Somaliland — Decree rendering applicable to the coast of French Somaliland the law of March 1, 1888 regulating fishing in the territorial waters. (*Journal officiel de la République française*, February 17, 1923).

Cameroon. — 1) Decree fixing the duty on tobacco exported from Cameroon. (*Ibidem*, February 4, 1923). 2) Decree organising and regulating

the testing of the kernels of the oil-palm before export from the territory. (*Journal officiel du Cameroun* March 1, 1923).

Togo. — 1) Decree of January 20, 1923 instituting, in Togo, the control of all cotton intended for export. — 2) Circular of January 21, 1923 relating to the inspection of cotton intended for export. — 3) Decree dealing with the protection of the palm in Togo; prohibiting the felling and export of timber trees for commercial and industrial purposes, and the carriage by rail of palm wine. (*Journal officiel du Togo*, February 1, 1923).

Island of Réunion. — Orders relating to the prohibition of export. The orders of April 5, 1914 and of April 14, 1920 relating to the prohibition of the export, or re-export, of agricultural products are abrogated. The exportation of: Mascari peas, "black peas" (*Mucuna* spp.) and "mimosa" (used as a stock-feed) and the re-exportation of wheat flour and rice are still, however forbidden; (*Journal officiel de la Réunion*, January 26, 1923).

Madagascar. — The decree of March 8, 1923 approving of the agreement entered into between the Governor General of Madagascar and its dependencies and the Society for the Exploitation of Madagascar fibres, by virtue of which this Society has been granted the right to gather fibre plants on the different parts of the State property of the Colony. (*L'Agronomie coloniale*, No. 64, April 1923).

Order obliging dealers to declare their stock of rice and enforcing the declaration of all rice intended for export abroad. (*Journal officiel de Madagascar*, March 17, 1923).

Organisation of Locust Control in the Countries of Equatorial Africa, in 1922. — In 1922, came into force the Convention drawn up in Rome on October 31, 1920, between French West Africa, Algeria, Egypt, Morocco, Tripolitania and Tunisia for the organisation of the international control of Acrididi (an exception being however made as regards Egypt and Tripolitania).

The decision come to as regards the opening of a preliminary enquiry respecting the migrations of the "sauterelles pélerines" (*Schistocerca galeata*), in the regions of Africa situated to the north of the equator has been carried out in these countries.

The Governor of French West Africa has made a valuable contribution in the form of maps and documents giving information respecting the successive generations of the insects in these regions and showing the usual itinerary of the invaders. The necessary arrangements have been made and the organisation has now begun work. The swarms of locusts are reported, as soon as they are seen, the warning being given by telegram and by information forms; in this manner, the migrations can be followed every day.

The information collected in Algiers is regularly communicated to the States belonging to the Convention of the International Institute of Agriculture in Rome and maps of the dispersions of the swarms are drawn up and sent every month to the above States.

The good results obtained by this agreement will certainly show themselves before long. (*Communication from the "Direction de l'Agriculture, du Commerce et de la Colonisation d'Algérie" at the International Institute of Agriculture*).

Importation of Live Plants and of Market-garden Produce from France into England and Wales. — Under the Colorado Beetle Order, dated December 15, 1922, which came into force on February 1, 1913, and was passed for the purpose of preventing the introduction of *Leptinotarsa decemlineata* Say, no live plants, or market-garden produce, from any French port may be imported into England, or Wales, without a special permit from an Agricultural Inspector, unless the said plants and produce be accompanied by a declaration from the grower, or cultivator, drawn up according to the form prescribed by the above-mentioned Order and stating that neither the live plants nor the market produce consigned have been grown in any of the following Departments of France: Gironde, Landes, Basses-Pyrénées, Hautes-Pyrénées, Haute-Garonne, Ariège, Aude, Gers, Tarn, Lot-et-Garonne, Tarn-et-Garonne, Aveyron, Lot, Dordogne, Corrèze, Cantal, Puy-de-Dôme, Creuse, Haute-Vienne, Charente, Charente-Inférieure, Indre, Vienne, Deux-Sèvres, Vendée, Loire-Inférieure, Maine-et-Loire, Indre-et-Loire and Lozère.

Law relating to the Export of Cattle into Great Britain. (December 1922). — Under the terms of this law (except in cases specially mentioned), it is permitted to import into Great Britain, Canadian breeding-cattle without their treatment, or slaughter, according to the provisions of the first part of the third appendix of the law of 1894 dealing with stock diseases. This law is provided with an appendix for the regulation of the trade in imported cattle. (*International Institute of Agriculture, Bureau of Legislation, Textes législatifs de l'année 1922*, No. 30).

Legislative Measures concerning Butter and Cheese in Canada. — From April 1, 1923, all Canadian butter and cheese intended for export shall be classed according to its quality, further, every factory must put the number of the tub on each cheese, or box containing cheese, and the number of the churn on each case of butter. (*La Gazette agricole du Canada*, Vol. X, No. 2, p. 179. Ottawa, March-April, 1923).

Law for the Encouragement of Agricultural and Rural Industries in Queensland (Australia). (August 15, 1923). — By means of this law, a Producers' Association has been founded under the name of the "Queensland Producers' Association", and with the powers, rights and obligations defined in the said law. (*Textes législatifs de l'année 1922*, No. 31).

Rabbit Nuisance Amendment Act. — Any person in possession of a license allowing him to destroy the rabbits on his property by means of traps is entitled to avail himself of this permission for a period of from 7 days to 3 months from the date of issue of the said licence, after which the use of traps for taking rabbits is forbidden without a special written permit. (*The New Zealand Journal of Agriculture*, Vol. XXV, No. 5, p. 315).

The New Zealand Dairy Industry Amendment Act of 1922. — This Act regulates the analysis of the milk fat to be used in the manufacture of milk-products and requires the managers of milk-product factories to register the amount of milk consigned by each producer and the yield of the said milk in cream, butter and cheese: a copy of the registration form must be given to every supplier of dairy produce. (*Ibidem*, p. 318).

Law of the Republic of Haiti of December 1922, concerning Long Leases. — The Government is authorised to grant leases of State

land for periods ranging from 9 to 30 years. Such land can however, only be leased for undertakings that will materially contribute to the agricultural progress of the country.

Measures for the Control of Plant Diseases in Italy. — By means of the ministerial decree of March 24, 1923, published in the *Gazzetta Ufficiale* of the following 28 April, the provisions of the Ministerial Decree of September 28, 1919 may also be applied to the control of the vegetable and animal parasites of plants mentioned in Art. 8 of the Ministerial Decree dated February 21, 1921 (cfr. *International Institute of Agriculture, Monthly Bulletin of Agricultural Intelligence and Plant Diseases*, Year X, (1919) Nos. 10-12, Art. 1260; *Ibidem*, Year XII (1921), No. 4, Art. 443).

By means of another Ministerial Decree published in the above-named *Gazzetta Ufficiale*, the control of *Ips typographus* L. is compulsory in the centres where this parasite has been observed. The rules and methods for its control will be prescribed by the "R.R. Osservatori regionali di Fitopatologia" in conjunction with the "R.R. Ispezioni forestali". The superintendence of the operations and the official control measures to be carried out, in cases of omission or delay, shall devolve upon the Staff of the Royal Forestry Inspection Service.

By means of a Ministerial Decree under date of March 15, 1923 published in the *Gazzetta ufficiale del Regno d'Italia* (No. 116 of May 18, 1923) the black aphid of peach-tree roots (*Anuraphis persicae* Boyer var. *niger* Smith) (1) is included in the list of parasites of which the compulsory destruction can be ordered by the Ministry of Agriculture.

Measures passed in Holland between April 14 and November 8, 1922, introducing Amendments of the Law of 1918 dealing with Horse-Breeding. — These measures regulate the appointment of State Commissions for Passing Stallions, of Commissions for Inspecting Pedigree Books and of Provincial Stock-breeding Committees; they also define the powers of the said Commissions and Committees, regulate the compilation by Breed Societies of a public pedigree-book and establish the prizes to be awarded to horse-breeders and the conditions under which they are given.

Law passed in Holland for the Amendment of the Law concerning Higher Agricultural and Veterinary Instruction. (December 1922). — This law obliges all the Professors to reside in the Commune in which is situated the University where their lectures are given.

Law passed in Holland for the Control of Contagious Diseases of Poultry. (December 1922). — Regulates the importation and transport of Poultry.

Order passed in Holland on January 15, 16 and 17 and on March 12, 1923, deals with the Laws respecting accidents to agricultural and horticultural workers.

Order of the Ministry of Agriculture of Holland under Date of February 15, 1923 concerning the qualities required in seed wheat.

Portuguese Law of July 31, 1922 relating to Cereals. — Law No. 1294 to which are appended regulations concerning the valuation and

(1) See R. 1923, No. 156. (Ed.)

importation of wheat, milling, etc. (*Boletim da Associação central de agricultura portuguesa*, Year XXIV, Vol. 24, No. 9, 1922).

Experiment Stations and Agricultural Instruction.

Agricultural Experiment Stations in Austria. — The work of these Stations is described in the Annual publication entitled *Zeitschrift für das Landwirtschaftliche Versuchswesen in Deutsch-Österreich*. The 1922 volume contains two articles, one written by O. RITMAR and giving an account of comparative manurial experiments made respectively with mineral phosphates and with "Reformphosphat" which the author considers to be equal in value to superphosphate, and the other by WERNECK-WILLINGRAIN, who treats of selection from the ecological standpoint.

School of Agricultural Mechanics at Mons (Belgium) — This school was founded in 1902 with the object of acquainting agriculturists with the most improved types of machines and teaching them how to handle, repair and keep them in order. This school was the first of the kind ever instituted either in Belgium, or elsewhere. In 1907, the School passed under the management of the Province which fitted it up with large plants. On November 4, 1920, the Provincial Council voted the credit necessary for opening a section for students learning to make agricultural machines. The workshop of this new section, which has an entirely modern equipment, started normal work on December 1, 1922, with a dozen students. The course of study and the apprenticeship last two and-a-half years. Pupil machine-drivers are not admitted under 16 years of age. They attend the courses and the repairs-workshop for 3 months and learn to drive and keep in order the machines by practical work in the open during the proper season. Particulars of the course and the regulations can be obtained from the "Direction de l'École de Mécanique agricole", 25 Boulevard des États-Unis, Mons, Belgique.

The Agricultural Station of Nyangwe, Belgian Congo, has been sold by order of the Crown to the "Compagnie cotonnière congolaise". Included in the sale are: one estate of 1000 hectares, buildings, and live-stock. (*Le Cultivateur belge*, March 10, 1923).

Canton Christian College. — Among the many branches of work engaged in by this College for the advancement of agriculture is that of the introduction of improved plants. One of the most valuable recent consignments was sent from the United States in February 1922. The citrus-tree collection of the College, which had before consisted solely of native species, was then enriched by the Washington Navel, Selecta, and Satsuma varieties of orange and by the Little River Grapefruit. Various citrus hybrids were also introduced with the object of testing them according to the system devised by the Office of Crop Physiology and Breeding Investigations of the Foreign Seed and Plant Introduction of the U. S. Department of Agriculture. A large collection of peach, almond, apricots and plums has also been acquired, together with a smaller number of pears, 6 species of pomegranates, specimens of *Carissa grandiflora*, *Macadamia terminalis*, *Acacia*, *Ariocarpus*, *Boehmeria*, *Cassia*, *Casuarina*, *Garcinia*, etc.

Secchium edule a common kitchen-garden plant of tropical America, and especially of Porto-Rico, has been introduced from California. It succeeded for a short time, but then died in spite of the rains of July and August. The pecan appears to do well in the Kwantung region. The College is continuing its acclimatisation work on a large number of arborescent plants from California, and on some specimens received from the Hawaii Agricultural Experiment Station. (*The Lingnaam Agricultural Review*, Canton Christian College, Vol. I, No. 1, Canton, December, 1922).

Seed Propagation Station at Zalla (Biscay, Spain). — The Zalla Station was founded in 1920. One quarter of its ground, viz., about 4 hectares is set apart for the improvement of agricultural plants, the rest being reserved for researches of local interest, such as the cultivation of various forage plants: Alexandrian clover, Hungarian moha (*Setaria italica* var. *germanica*), green Californian moha, early Caucasian moha, Etampes soybean, etc. Other plots are devoted to growing vines, including direct bearers, and to pasture. The following species cultivated in the district are being selected: wheat, maize, garden-beans, horse-beans, beets, potatoes, turnips and capsicums. The wheats studied come from ears gathered in the different zones of the Province, or from samples sent by the "ayuntamientos" (municipalities) of the Basque district, or from wheat cultivated at the Station of La Moncloa (Madrid) or imported (having been supplied by Messrs. VII-MORIN-ANDRIEUX of Paris). To this work must be added 936 "cengenarcas" of pure lines. Messrs EGULEOR and ARZADUM are respectively the "jefe" and "ayudante" of the "Servicio agrcola" which controls the work of this Station. (*Estación central de ensayos de semillas. La Moncloa, Madrid, Boletín trimestral*, Year II, No. 7, pp. 9-11, Madrid, 1922).

Popularisation of Agricultural Science in the United States. — The Ministry of Agriculture of the United States has published (*Circular No. 253* February 1923) statistical data of the funds at disposal for the fiscal year 1922-23 for this propaganda work (Co-operative Extension Work) in which, during July 1922, 4387 persons were employed. In the 1922-23 budget, 18 821 000 dollars were allocated for this purpose, of which 5 880 000 dollars were furnished by the Federal Government (Smith-Lever Act) and the rest by the various States and local Public Bodies.

Agricultural Experiment Station of Rhode Island State College, United States. — *Bulletin* No. 190 of this Station deals with the assimilation powers of certain cereals and their susceptibility to fertilisers. By assimilation is understood the capacity of the plant to abstract from the soil the substances necessary to its existence without recourse being had to fertilisers. The bulletin gives the results of 10 years' experiments made in the field and in pots with the object of determining this capacity.

Agricultural Experiment Station of the University of Maryland. — *Bulletin* No. 249 of this Station contains a report of the Seed-control laboratory for 1921 during which year 460 samples were tested.

Agricultural Experiment Station of Wisconsin University Madison. — *Bulletin* No. 346 of this Station, entitled Marketing by Co-operative Sales Companies, treats of the co-operative sale of Wisconsin cheese by means of these Sale Companies. The cheese has been sold in this way

for 8 years by the Wisconsin Cheese Producers' Federation. The success obtained warrants the foundation of similar Companies for the sale of butter, tobacco, livestock and other agricultural products. The bulletin explains the special advantages of Co-operative Sale Companies and suggests a scheme for their formation.

Texas Agricultural Experiment Station. — *Bulletin* No. 298 of this Station bears the title of, "Commercial Fertilisers in 1921-1922", and treats of the State control of these manures; it also gives several tables of analyses of chemical fertilisers made in the various factories of Texas. *Bulletin* 300, "Organic Constituents of the Soil", deals with the nitrogen and organic substances present in soil. *Bulletin* No. 301 "Soils of Bell, Jefferson, Smith, Taylor and Well Countries", treats of the chemical composition, fertility and manurial requirements of the soils in these Provinces. *Bulletin* No. 302, "The Needs of the Soils of Brazos and Jefferson Counties for Sulphur", discusses the sulphur content of these soils and the effect of sulphur manuring upon crops.

Experiment Station for Citrus Growing at Riverside, California. — By means of pot cultures of barley, it has been proved that the productive power of a soil is not the same in the case of barley and of citrus-trees. The amount of nitrogen previously applied is no exact criterion of the capacity of a soil for barley production. In the soil used, phosphatic and potassic fertilisers had no effect upon either the barley, or the citrus crop. (*The Botanical Gazette*, Vol. 75, No. 1, p. 95, Chicago, 1923).

Soil Bacteriology at the Pasteur Institute in Paris. — A Section for soil bacteriology has been instituted at the Pasteur Institute in Paris and is entrusted to S. WINOGRADSKY, formerly Director of the Institute of Experimental Medicine, in Petrograd.

Instruction in the Trade of Cooper in France. — At Auxerre, a school has been opened for coopers. The course begins in October and lasts 15 months. Students are not admitted under the age of 14. The course entails 48 hours of work weekly, 40 in the workshops and 8 devoted to general oral teaching. The casks made will be sold and the returns, after deduction of the cost of materials, will be divided into 3 parts giving respectively to the student, the teacher and the reserve fund.

Agricultural Services and Experiment in French West Africa. — In the course of his report on the economic conditions of French West Africa, the Governor-General of the Colony described to the Council the experiments that had been made in the Niger Valley with a view to cotton-production. The cotton-growing company installed at Diré has obtained encouraging results on irrigated land and has been granted a concession of 2000 hectares. Other companies propose cultivating cotton without the help of irrigation. "The Association Cotonnière" is trying to get the natives to grow cotton on their land and promises its support and advice to all willing to make the attempt; this method has been adopted by the English with conspicuous success, on the Gold Coast, in the case of cacao production. In accordance with the provisions of the decree of August 16, 1922, the Government of French West Africa has founded several Experiment Stations of which those devoted to cotton-growing, the cultivation of the ground-nut and the oil-palm have

already begun useful work. (*Bulletin agricole de l'Algérie-Tunisie-Maroc*, Series 2, Year 29, No. 3, Algiers, 1923).

Agricultural Work in Dahomey, French West Africa. — The studies made in Dahomey have shown that a very large number of crops can be cultivated there. Many were already being grown with success viz., the oil-palm cocopalms, maize, cotton, tobacco, karité (*Butyrospermum Parkii*), kapok, indigo, manioc, yam, spp., rice, millet etc., while others have been imported with excellent results by the Agricultural Service. The latter plants include: indiarubber, cacao and coffee trees, kola, castor-oil, sisal, zapupe, filao (*Casuarina*), teak, *Cedrela odorata*, and various fruit and forest trees. The Stations of the Agricultural Service are fairly numerous in Dahomey, but have hitherto had only the character of Trial Stations. Henceforward they specialise in one of the most important crops. — 1) *Station for the coco-palm.* The most suitable area for the coco-palm is the strip of land along the coast which ought soon to be thickly planted with this valuable tree. The work of this Station is the formation of large nurseries of selected oil-palms. — 2) *Maize Station.* Maize is grown throughout the Colony but is most cultivated in the districts of Allada, Sakété and Pobé. The Sakété Station will be chosen as the centre for the study of maize. Some years, as much as 30 000 tons of this cereal have been exported from Dahomey, but this amount cannot be maintained, because the grain, although sound when on the plant, spoils very quickly. The object of the Station will not be so much to intensify maize cultivation, as to improve it and discover practical means of keeping the grain in good condition. It will also try and devise a mechanical shelling method. — 3) *Cacao and Coffee Station.* Both cacao and coffee have yielded excellent results, especially in the Allada and Mono districts. The Niaouli Station, which is the largest in Dahomey, will in future confine its attention to these two crops and will make extensive nurseries. — 4) *Cotton Station.* Cotton is grown in Middle and Upper Dahomey. Two Stations are to be established for this valuable crop, one at Abomey and the other at Savalon. The local varieties with hairy seeds have been improved by the introduction of other varieties with smooth seeds and fairly long lint. The chief work of the Station consists in choosing smooth seeds for distribution to cotton-growers at the sowing season. — 5) *Tobacco Station.* Tobacco is cultivated in the whole of Upper Dahomey the climate and soil of which are most suited to this plant. The Tobacco Station will be at Parakou and will occupy itself with the technique of tobacco cultivation. (*L'Agronomie coloniale*, Year 8, No. 61, pp. 24-27. Paris, 1923).

Station for the Selection of Oil Palms in Togo. — Owing to the agrological conditions of Lower Togo, the district of Tabligo-bo is the only part where a Station for the Selection of Oil Palms could be established. Here, on the basis of the small experimental Government plantation dating from the time of the German occupation, it will be possible to make a plantation of selected *Elaeis* trees supplied by the Dahomey Experiment Station, for with proper protection the young palms will do well. It seems only necessary to make one model plantation which is systematically managed. The laboratory will have to be started later, when the Station begins secondary selection and the regular distribution of selected trees to the planters. The

difficulties caused by the isolation and remote situation of Tabligo-bo will soon be removed when the railway is made, the only difficulty then remaining will be the water supply. The locality offers the advantages of a suitable climate and soil, natives used to growing oil-palms (although without direction), and the immediate proximity of a vast region to be gradually planted with oil-palms. (*Bulletin des matières grasses de l'Institut colonial de Marseille*, No. 1, 1923).

Farm-Schools at Guelma, Algeria. — A farm-school attached to the Guelma Experiment Station will be inaugurated in November 1923, the management will be placed under the control of the General Government. It will take native pupils chosen as far as possible from among the sons of agricultural proprietors. The aim of the school is to give a sound, professional, agricultural education especially adapted to the crops and stock-breeding of the area in which it is situated.

The Foundation of a School of Applied Science at Hanoi, Indo-China. — An Order of the Governor-General has added to the Higher Schools forming the University of Indo-China, a new school of Applied Science. The task of this new school is to train experts for the Public Administrations of the Colony and for private chemical, electrical, or mining industries. There are 5 sections: Public Works — Industrial Chemistry — Electricity — Mining — and a higher course of Topography and Agricultural Valuation. (*Annales de l'Institut colonial de Bordeaux*, p. 27, 1923).

The Development of Genetics Applied to Agriculture in Indo-China. — The necessity of improving the agricultural plants, and especially rice, in Indo-China was felt in the beginning of the French occupation. The many attempts which had begun as early as 1870, yielded scanty results, because genetics, as a science applied to agriculture had as yet no fixed principles and technique.

In 1913, the Governor of Indo-China decided to found a laboratory for rice selection at Saigon; this laboratory now forms part of the Service of Genetics treated for the purpose of extending in all the countries and to all the crops of Indo-China the work hitherto confined to rice in Cochinchina.

As regards rice, the first thing to be done is to determine and study the varieties supplying the best products for export and industry, without however neglecting the varieties intended for local consumption which often differ greatly from the other types. The amount of rice consumed locally is certainly not less than three million tons, the quantity exported being scarcely half as much.

A list of the varieties of rice capable of yielding good products must be compiled with due regard to agricultural conditions, the soil and climate being taken into account, since these factors greatly influence the productivity of the rice plant. In the laboratory of Saigon, 3000 individuals have so far been thoroughly examined and their germinative power as affected by the controlling factors is now being studied with the object of discovering any possible morphological, or physiological, correlations that may assist in the work of selection, etc.

Over 150 varieties have been introduced (from Japan, China, India,

Madagascar, Persia, Argentina etc.), in order to determine which of them can be acclimatised and used for further crossing.

The work of the central laboratory is completed by the Seed Garden ("Jardin de Semences") of Phu-my, and by the Cantho Rice-Growing Station with its four increase plots. This Station is already well-known to the rice-growers of the Far East. It now distributes at market prices the seed of the selected varieties, Hueki and Kamay. The amount of rice annually sold, which is only $\frac{1}{4}$ or $\frac{1}{8}$ the quantity required, already reached 60 tons, sufficient to sow 2500 hectares and produce a crop of about 600 tons.

The products of the first generation are sold separately for seed and find increasing favour among the agriculturists. The exporting firms value selected rice and offer a higher price for consignments accompanied by the form vouching for its authenticity given by the Service of Genetics.

The work of rice-selection has recently been extended to Tonkin, and is carried on at the Agricultural Sections of Tuyen-Quang and Phu-Thô. (*La Vie technique et industrielle*, pp. 17-19, Paris, 1923).

Seed Control in England in 1921-22. — The annual report of the Official Seed Testing Station for the year 1921-22 has been published recently by the National Institute of Agricultural Botany in its technical report for 1922. The above-mentioned report may be summarised as follows: The number of seed samples tested was 25 822, viz., about 2000 more than in any preceding year. In March 1922, 5185 samples were examined. The number of agriculturists making use of the Station was 35 % more than in the preceding year. There was a great increase in the number of cereal and red clover samples submitted and a decrease in the leguminous samples sent, while the numbers of samples of other species had not greatly changed. As was to be expected after the very dry summer of 1921, the quality of locally grown seeds was better than usual.

Cereals: The germinating power of barley and wheat will much exceed the average for previous years, while that of oats and rye is about the same as the average for previous years. A large increase was noticed in the number of wheat samples infected with rust or darnel, while the rye was less infected than usual by ergot.

Roots and Kitchen-Garden Plants. — As a rule, the germinating power of the seeds was slightly above the average, but the quality of the seed samples of parsnips, carrots and onions was not as high as could be desired. The quality of the mangels and sugar beets was good.

Forage Leguminosae. — The average germinating capacity of English red clover seed was 83.6 % as against 76.3 % in preceding years. The purity of the seed was greater. English white clover showed similar improvement, but to a lesser extent. The quality of the lupins was improved. The Czecho-Slovakian clover seeds that contained many impurities the two previous years, were much superior last year. The percentage of dodder present in all the forage leguminosae was a little higher than in the year before.

Forage Gramineae. — It is somewhat difficult to compare the 1922 data for purity and germinating capacity with those of the preceding years, because the method of analysis has been entirely changed. The adoption of the system used on the European Continent has resulted in lower figures being

obtained for purity and higher ones for germination. It seems however, that the seeds of the rye-grasses were below the average, while those of the Phleum and Meadow Fescue seeds were up to the average. (*The Journal of the Ministry of Agriculture*, Vol. XXX, No. 1, London, 1923).

The West Indian (Trinidad) Agricultural College. — This was opened in October 16, 1922, and at the end of the first year, the progress made gave promise of its future success. In the next academic year, a 3 year course of tropical agriculture will be began; specially favourable terms will be made to students of other Universities, or Higher Schools, wishing to attend this course with a view to extending their knowledge of tropical agriculture, or to carry out experimental research under tropical conditions. The organisation of the technological sugar course is not yet completed, but a model sugar factory will soon be equipped. (*Nature*, No. 2802, 1923).

Cotton Research and Teaching Institute in the Transvaal. — The Transvaal University proposes to found an Institute for cotton research to work in collaboration with the Department of Agriculture, Tobacco and Cotton Division. Amongst other questions studied there will be the control of the plant and animal parasites of cotton, the formation of standards, the length and tenacity of the lint, the spinning quality of South African Cotton, and the general development of the cotton industry. (*Journal of the Department of Agriculture, Union of South Africa*, Vol. VI, No. 2, 1923).

Royal Experiment Station at Reggio Calabria for the Industries of Citrus Essential Oils and Derivatives. — This Station was founded by Decree No. 213 of the Lord Lieutenant under date of June 1918, and has recently started work. Its chief objects are to: carry out analyses and experiments at the request of the public and of the public Administrations; study questions concerning the production of citrus essential oils and derivatives; conduct experiments and promote the cultivation of plants for the perfume, unguent, soap and other industries, study the local flora in order to obtain perfume plants; acclimatise, cross and select perfume plants. The Station has begun preparing and studying the essential oils of citrus-trees, basil, *Origanum*, *Artemisia aborescens*, etc. (*Atti del R. Istituto d'Incoraggiamento di Napoli*, Series VI, Vol. LXXXIII, Part I, pp. 59-65, Naples, 1922).

Re-organisation of Cheese-Making Research and Instruction in Italy and Abroad. — About 40 million hectolitres of milk are produced annually in Italy, at least half being absorbed by the dairy industries, while the rest is consumed in its natural condition. There are over 6000 cheese factories in the country; these are situated chiefly in Lombardy, Emilia, Piedmont, and Veneto. Less than 1200 of the factories are run on co-operative lines, and about 80 % do not work up more than 10 quintals of milk per day. The annual output of dairy products is about 2 million quintals of cheese and 250 000 quintals of butter.

The existing scientific and teaching institutes devoted to the dairy industry are: 1) The Experimental Cheese-Making Institute at Lodi (its function is chiefly didactic); 2) The Royal Stock-breeding and Cheese-making School of Reggio Emilia; 3) the Cheese-making Section attached to the School of Practical Agriculture at Brescia. Cheese-making courses are also held by the Travelling Agricultural Schools of: Udine (in the Dairy-School at Piano

d'Arta), Sondrio, Bergamo and Milan; a section for practical instruction in cheese-making has been opened at the Agricultural School of San Michele, in Trentino, and short courses in cheese-making are held at intervals in several Agricultural Schools, especially in that of Sassari.

The chief foreign institutes for research and instruction in cheese-making are:

Switzerland: 1) Agricultural Experiment Institute of Liebefeld, near Berne, founded in 1901 and divided into the following sections: a) Institute of Agricultural Chemistry; b) Experimental Cheese-making Station with dairy attached; c) Bacteriological Laboratory; d) Cantonal School at Rütli (Bernische Molkereischule), which also acts as an Experiment Station especially in technical matters; 3) Dairy School annexed to the Friburg Institute of Agriculture; 4) Cheese-Making School at Moudon.

France. — As a rule, cheese-making is taught in the Higher and Secondary Agricultural Schools where courses of 18 to 20 theoretical lessons in dairying are held. At the Rennes National School of Agriculture, a supplementary theoretical-practical dairy course lasting one year is held. The dairy schools of highest standing in France are those of Poligny and Mamirolle. The practical schools of agriculture and dairying give elementary instruction in the second and last year of their course. The Dairy Station of Surgères (Charente-Inférieure) is chiefly engaged in research on butter.

Germany. — In 1922, this country had 16 scientific dairy institutes counting the properly so-called Dairy Stations ("Milchwirtschaftliche Institute"), and the Experimental Cheese-Making Sections attached to Agricultural Stations. The Cheese-Making Schools were 23 in number, some of them being attached to Experimental Cheese-Making Stations, or Agricultural Schools. According to the amount of instruction given they are divided into Higher Schools with a two years course, and Lower Schools with a six-months course.

Sweden. — 1) Dairy Institute attached to the Higher Institute of Agriculture at Alnarp; where a higher and a lower course are held; 2) Dairy Experiment Station at Hamra, instituted by the Separator Company; 3) Numerous practical Dairy Schools belonging to private cheese-factories.

Hungary: 1) Higher Dairy School at Szwab; 2) 5 practical dairy schools for male and female students to be trained as fore-men and fore-women.

Argentina. — The largest institute where cheese making is taught is the National School of Dairying and Pasture-Cultivation ("Escuela Nacional de Lechería y Prácticultura") of Bell Ville, near Cordova, which is divided into three sections, for dairying, stock-breeding and forage-growing respectively.

The following are the chief suggestions made by the author: The creation of: 1) an Office at the Ministry of Agriculture for the general coordination of the Cheese-making industry; 2) A Technical College of National Cheese-making composed of the technical experts in the country. This College should meet at the Ministry of Agriculture and draw up an annual programme for the dairy industry, based on the recommendations made by Experiment Stations, Cheese-making Schools, Dairy Schools, Cheese-making and Commercial Organisations). The statistical, technical, professional, experimental, commercial and legislative sides of the question must all be taken into account, and the work done in the country annually noted and estimat-

ed with a view to making known the most tangible and immediately practical and economic results and also to obtaining a basis upon which to formulate regulations to be incorporated into new programmes aiming at a further extension of the existing work.

The executive organs of these programmes must be the Experiment Institutes, the fixed cheese-making schools, the travelling cheese-making schools, the commercial organisations and public bodies engaged in drawing up the cheese industry statistics and in recording the progress which is gradually being made in this important branch of agricultural work.

3) Institute for Research and Higher Instruction in cheese-making.

4) Fixed cheese-making Schools.

5) Travelling Cheese-making Schools. (G. FASCETTI, Riorganizzazione della sperimentazione e dell'insegnamento del caseificio in Italia, *Annali dell'Istituto sperimentale di caseificio di Lodi*, Vol. I, Nos. 5-6, p. 151. Lodi, 1922).

Experiment Laboratory of Phytopathology in Turin. — Under the Royal Decree of April 26, 1923, No. 1024, the Autonomous Phytopathological Observatory of Turin — established by Royal Decree of May 3, 1914, No. 425 — takes the title of Experimental Laboratory of Phytopathology, and assumes the functions of Regional Phytopathological Observatory which were previously exercised by the Autonomous Phytopathological Observatory of Turin.

Report of the Experiment Station for the Cultivation of Java Tea (West Indies), for the Year 1922. — 1922 was a year of much economic difficulty which increased the work of the Station. Owing to the desire of reducing labour, most of the plantations were less carefully tended, with the result that the plants were more attacked by animal parasites and by disease, although in other cases, an attempt was made to face the crisis by improving the quality of the product. Whichever plan was adopted, frequent recourse was had to the advice of the Station, 2600 requests for consultations being received in 1922, as against 1200 to 1300 in the preceding years. In spite of the crisis, the number of members contributing to the up-keep of the Station has fallen off but very little.

An attempt was made in 1922 to amalgamate the Tea Experiment Station with the Indiarubber Station of West Java, this amalgamation will probably be definitely effected in 1923. The report states that 84 plantations were inspected in 1922.

Diseases. — As a rule, the tea had suffered from "red rust" and the attacks of *Helopeltis*. Owing to the drought, injury was also done by *Brevipalpus*, *Tarsonemus*, *Phytopus* and *Tetranychus*, especially in the east and central parts of the island. Serious damage caused by red spider (*Tetranychus bioculatus*) was noted for the first time in one plantation. This parasite, which is much dreaded in British India, has been successfully controlled by various insecticides, those with a sulphur base being specially effective.

Some plantations have suffered from the attacks of larvae: *Andraca bipunctata* in Java and *A. apodecta* in Sumatra. The presence of a geometrid (*Buormia*), whose parasite is unknown, has been recorded for the first time.

An *Acanthopsyche* habitually parasitic on *Albizia* has caused great injury in Sumatra both to its accustomed host and to the tea-plant. The attacks

of *Phyllosticta*, *Microserica*, and *Helopeltis* have been successfully controlled in the above island. The following root diseases have been reported from some plantations: *Armillaria* (which disappears in 6-8 years), *Rosellinia*, *Fomes* and *Doria* (controlled by surrounding the infected areas with deep trenches and liming the soil of the plantation).

Green Manuring. — The economic trouble has helped to convince many planters of the use of green manure. A large number of tests were made with leguminosae in 1922.

Tea-seed is only controlled to a limited extent in Java.

Experiment Ground. — The Government has promised the Station 120 hectares of land, which will be placed at its disposal in 1923. At Tynjirean, the Station possesses sufficient ground for 20 tea-gardens for the production of selected seed; half this land has already been cleared.

Chemical work. — In 1922, 1600 soil samples and 1000 samples of tea were analysed.

Botanical work. — In 1922, the first microscopic preparations of tea-leaves were made. The study of the root system of the tea-plant (concerning which all data were practically wanting) has also been begun.

Selection Work (1).

The report also contains some further entomological observations and promises that special publications on this subject will be forthcoming.

The correlation between the production of some plantations and meteorological factors is shown by two diagrams and several tables. (*Mededeelingen van het Proefstation voor The. Verslag over het jaar, 1922, No. LXXXIII, Batavia, 1923*).

Forage Plants Introduced into the Republic of Dominica. — The "Estación agrónomica" of Haina has introduced and acclimatised the following forage plants of which it has already begun to distribute small quantities of seed to agriculturists: "yerba elefante" (*Pennisetum purpureum*), and "caña japonesa", or "caña Uba" (*Saccharum japonicum*), heavy yielders for cutting — "yerba Natal" (*Tricholaena rosea*) and "yerba Rhodes" (*Chloris Gayana*) pasture plants — "Kaffir corn" (a variety of sorghum) cow pea (*Vigna Catjang*) for poultry feeds. The first four are distinguished by their drought resistance. (*Secretaria de E. de Agricultura e Inmigracion, República Dominicana, Revista de Agricultura, Year XVII, No. 1, p. 45, San Domingo, 1922*).

Swiss Forestry Station. — In Vol. XII (1922) of the *Mitteilungen der Schweizerischen Centralanstalt für das forstliche Versuchswesen*, Dr. E. ENGLER publishes an article dealing with the physical properties of arable and woodland soils. The first part describes the practical methods adopted in research on the physical properties of soil (determination of the solid volume, of the volume of water, the volume of air and of permeability).

Congresses and Conferences.

The Recommendations of the XI International Congress. — On May 28 last, the *Congrès international d'Agriculture*, which had been attended

(1) This subject, on account of its great importance, will shortly be treated in detail in a following number.

by the delegates of many States, terminated its work at Paris. At its closing Session, the International Agricultural Commission was complete, the representatives of two new States, Poland and Czecho-Slovakia being also included.

Then follow, expressed in brief terms, the resolutions passed and the recommendations made by the Congress with a notice to the effect that those recommendations, which specially refer to general questions of agricultural economy, are given *in extenso* in the *Rivista Internazionale delle Istituzioni Economiche e Sociali*, Year I, No. 3.

I SECTION: AGRICULTURE. — 1) *The Legislative protection of new plants*, which are to be regarded as patented products, exact and severe regulations to be passed to prevent the fraudulent sale of new varieties of seed-wheats and to control the names under which they are sold. — 2) *The Constitution of an International Association of Plant Selectionists* supported by the various Governments and connected with similar national Associations. — 3) *The Co-ordination of Studies of Cereal Rusts*, it being suggested that for the present, HAVES and STAKMAN'S scale should be adopted for determining rust resistance. — 4) *Protective Measures Against Degeneration in Potatoes* based on systematic conducted studies, the encouragement and popularisation of seed tubers election, the selection being controlled and guaranteed by a certificate of authenticity, the immunity of the seed potatoes from the serious parasites, *Doryphora* and *Synchytrium* being especially vouched for by a certificate of the country of origin. — 5) *The widest employment of agricultural machines* favoured by the Governments and Associations and the organisation of practical instruction for rural mechanics.

II SECTION: *Influence of Agriculture upon International Relations*. — 1) *Development of international relations between Agricultural Associations with the object of peace propaganda* (See, *Riv. Int. delle Istituzioni Economiche e Sociali* mentioned above). — 2) *International Institute of Agriculture*. Recognising the services already rendered by this Institute, the Governments ought to study the means by which its efficiency can be increased, in order that agriculturists may in their turn derive the fullest benefit from its work. — 3) *Unification of the methods of customs control* on the basis of the conclusions announced by the International Conference held at Paris in 1910. — 4) *Regulation of the trade in commercial products* (See, *Riv. Int. delle Istituzioni Economiche e Sociali* already mentioned).

III SECTION: *Rural Economy*. — For most of the recommendations made respecting this section, and in particular for: 1) *The material and moral improvement of rural workers*; 2) *Agricultural Associations*; 3) *The System of Land Transfer in various countries and the means of reducing its cost*; 4) *Agricultural profits and fiscal burdens on agriculture*; 5) *Financial independence of professional agricultural organisations*; 6) *Agricultural Politics*; 7) *Improvement of the social conditions of agricultural workers*, See *Riv. Int. delle Istit. Econ. e Soc.* mentioned above. As regards agricultural book-keeping, it was suggested that the elementary knowledge of this subject should be imparted in rural districts both by means of instruction in the schools and text books in the subject, and that co-operative societies should institute special book-keeping offices for the assistance of all agriculturists and especially of the poorest; special

instruction being provided for training administrators, directors, and book-keepers for the various agricultural associations. It was also suggested that similar methods of analysing agricultural management should be adopted in all countries, in order to facilitate international exchange of views.

One of the suggestions made by Section III, Sub-section of *Agricultural Instruction* (See *Riv. Intern. d. Econ. e Soc.*) was that the *primary schools* should have specialised teachers and that the theoretical instruction should be supplemented by practical demonstrations in the gardens annexed to the school, in the fields and neighbouring farms. At the same time, the professional career of the teachers who devote their time to imparting agricultural knowledge must be considered, either by promoting them on the spot, or giving them certain increments to their salaries, or scholarships for their children, so that they may provide their family with as good an education as if they lived in the town. As regards *trade schools*, the development is recommended of winter schools, schools of domestic economy, continuation schools, apprenticeship instruction, correspondence classes, regimental schools, etc.

IV SECTION: *Cattle Economics*. — 1) Institutions for the control of the yield and feeding of milch cows would afford a means of developing and selecting dairy stock. The Congress not only recommends an extensive propaganda in order to extend the cultivation of forage crops, but also urges the institution and development of co-operative dairies, the formation of syndicates for the common purchase of breeding stock, and the wholesale purchase of stock-feeds, fertilisers etc.; the development of good cheese-making schools; the organisation of rapid means of transporting milk and its derivatives; the adoption in the different countries of uniform measures for controlling milk and butter production (sample-taking, weighing, certificates); the practical and scientific instruction of expert milk controllers — 2) The Congress urges the necessity of the different countries to adopt the same rules for judging breeding-stock (these rules being in accordance with the principles directing scientific breeding) and the regulations for the registration of stock in *pedigree books*. The latter, for instance, should be *closed*, and after they are closed, no animals should be registered unless they are the offspring of parents already on the register, in which case, as a rule, a confirming test is also to be required. — 3) the adoption in the various States of *health certificates* and of *certificates of origin*, like those granted in Holland, was also recommended. — 4) The formation of a *Permanent International Breeding Office* to deal with matters relating to the improvement and economics of live-stock was proposed. — 5) *The unification of breeding methods* was recommended. — 6) Also a detailed book-keeping system supplying exact data respecting mechanical traction, and finally — 7) the Congress recommended that the study of foot-and-mouth disease should be carried out in all the different States.

V SECTION: *Vine-growing*. — It is recommended that: 1) the Countries which signed the Treaty of Versailles should proceed to the unification of the laws made for the purpose of protecting the *declaration of origin of wines* by extending the *Convention of Madrid* and organising a Committee of the Latin Union to consider the international measures to be taken for the purpose of insuring the genuineness of the said products — 2) the methods of chemical

analysis should be unified in accordance with the Paris Convention, October 16, 1902 — 3) the attention of the various Governments should be drawn to the exaggerated measures of the Prohibition campaign — 4) in spite of the progress attained in *crossing vines*, in order to avoid the economic consequences of over-production, no undue extension of vine cultivation should be attempted. In no case, should hybrid bearers be used in districts producing fine wines.

VI SECTION: *Sylviculture*. — The Governments should: 1) encourage the intensification and improvement of forest-tree cultivation by means of pecuniary assistance and other support both of a material and moral character. — 2) Combine to coordinate forestry studies of a strictly technical nature. — 3) Develop measures of protection and insurance against forest fires.

VII SECTION: *Agriculture in Tropical Countries*. — 1) *The Development of Colonial Agricultural Products* by means of close collaboration between the Administrations of the colonies and individual traders, and by extending the technical knowledge of the natives engaged in various branches of agricultural work. — 2) *Economic development of stock-breeding and the control of epizootic diseases*. — 3), 4) and 5) *Financial problems of the Colony, the feeding, medical assistance and recruiting of colonial workers* (See, *Riv. Int. d. Istitut. Econ. Soc.* above mentioned). — 6) It is recommended for the protection of tropical crops that regulations should be passed in all the Colonies, in accordance with the final resolution of the International Conference at Rome, of March 4, 1914, and suitable offices established in the several Colonies. — 7) In order to extend the use of improved methods in growing Colonial crops, it is recommended that scientific institutes and museums should be founded, and assistance given to scientists desirous of studying colonial agriculture. — 8) It is finally recommended that engines running normally on motor fuel should be studied, in order to extend the use of *Agricultural tractors*.

International Conference for the Study of Means of Controlling the Olive Fly ("mosca delle olive") Madrid, June 18-21, 1923. — This Conference, which was announced in No. 1, of the present Review, (see p. 257) had been convoked on the initiative of the Spanish Government as a result of a decision made by the International Institute of Agriculture in Rome, and was held in Madrid in the building of the "Ministerio de Fomento" from June 18-21, 1923, being attended by the representatives of France, Greece, Italy, Peru, Portugal and Spain.

The Conference passed the following resolutions:

1) That it is advisable to create compulsory associations amongst olive-growers for the defence of their property against the Olive-fly (*Dacus oleae*).

2) That it is necessary to continue the experiments connected with the artificial control of the olive-fly. These experiments should be continued for 3 or 4 years in the same place and under the same conditions in order to compare the results and decide as to the effectiveness of the remedies.

3) That since both spraying with toxic and sugary substances, and the use of locally-set poisoned baits have been considered effective in various countries, the Conference is of opinion that both these methods should be studied, without however excluding any other remedies which each State may consider to be effective in the control of the pest.

4) In so far as the laws controlling the use of arsenates in agriculture permit (for these differ in each State), the Conference is of opinion that it is advisable to begin new experiments based on the use of arsenical compounds other than the soluble arsenates hitherto employed, and recommends especially lead arsenate and other products toxic to the olive-fly.

5) The Conference expresses the hope that the International Institute of Agriculture in Rome will cause the question of patents to be studied, so that the maximum liberty may be granted to the olive-growers in the use of artificial means of destroying the olive-fly.

6) The Conference is of opinion that the results of all the experiments, together with the details respecting the application of the remedies in different countries should be laid before the International Institute of Agriculture, in Rome, in the first half of October in each year. The Institute should communicate the said results to the interested countries without any loss of time.

7) The Conference considers that it will be necessary to discover whether the methods hitherto employed, and which are recognised as destructive to the olive fly, may not also prove injurious to the olive-tree owing to the possible development of fumagine and the destruction of useful insect parasites of the olive-fly which like the latter, live on sugary substances.

8) That all olive-growing countries should appoint experts to study, according to a common plan, the life-history of the olive-fly and its parasites, with special reference to the environmental conditions. The creation of insectarii with experiment fields is especially to be recommended for this purpose.

9) The Conference expresses the hope that the Governments of European olive-growing countries will urge those of North Africa, India, South Africa and West Africa to make an exhaustive study of the olive-fly and its parasites in their several regions.

10) An endophagus parasite (*Opius concolor*) of the olive-fly having been met with in North Africa, the Conference is of opinion that a common effort should be made to acclimatise this parasite in Europe.

11) Given the existence of endophagous and ectophagous parasites of the olive-fly in West Africa, a country with a climate resembling that of South Europe, the Conference advocates a united effort being made to introduce these parasites into Europe.

12) The Conference expresses the hope that a permanent International Commission of experts will be appointed with a view to studying the various questions concerning the olive-fly. This Commission should meet at least once a year. The first meeting should be held at the International Institute of Agriculture in Rome. The place of the following meeting shall each time be fixed at the meeting.

13) The Conference recommends the various Governments to found in the manner they think most suitable "Olive Banks" of which the funds will chiefly be used to control the olive-fly.

14) The Conference hopes that the various States will agree to unify the national legislation with the object of facilitating the purchase and employment of the substances required for the control of the olive-fly, a pest to man and animals.

15) The Conference hopes that the Fiscal Authorities will reduce the taxes on substances intended for olive-fly control.

16) The Conference considers it necessary to extend judicious protection to many birds which render service in destroying insects, especially those into the olive-tree.

International Wine Conference. — On June 4, 1923, was held at the French Ministry of Agriculture, an international conference of wine-producing countries for the study of the following questions: propaganda, unification of the regulations adopted in vine-growing countries for the repression of fraud and the protection of declarations of origin — the creation of an international wine office for the application and co-ordination, in every State, of questions of international control.

Pomological Congresses in France. — 1) *Congress of the "Société pomologique de France"*, Strasburg, September 7-8, 1923, inaugurated under the auspices of the "Association Centrale des Arboriculteurs d'Alsace et de Lorraine", and of different horticultural societies united for the purpose. Questions treated of: 1) The object and organisation of experiment orchards; 2) Partial soil sterilisation in fruit-culture; 3) Effect of climate upon the intensive cultivation of table fruit; 4) The best treatment of trees in intensive fruit-growing; 5) Causes determining tree-fertility and fine fruit; 6) Grafting: effect of scion on stock; 7) Note and observations on rolling, moulds, *Monilia*, and on pruning fruit-trees; 8) Study of Alsatian fruit-growing. Communications to be addressed to the Secretary-General of the Société pomologique de France, M. Louis Chasset, 1 Rue Saint-Symphorien, Versailles.

2) *Pomological Congress of Toulouse.* — The "Société pomologique de France" has agreed to meet and hold a Congress in 1925 at Toulouse, under the auspices of the "Société d'Horticulture de la Haute-Garonne", and the "Compagnie des Chemins de Fer du Midi". At the same time an Agricultural Industrial Show will be held.

National Agricultural Congress in China. — The report of this Congress, which was held in 1922, can be obtained from Dr. P. W. TSOU (Dean of South Eastern University), Nanchino, China, (See *World Agriculture*, Vol. III, No. 1, pp. 15-22-23).

Association of Official Agricultural Chemists of New York. — The 39th meeting of the Association was held from November 15 to 17, 1922, at Washington, 360 members being present. In addition to the usual reports, various papers were laid before the Association. In connection with the reports of the food experts, BAILEY of the Society of American Oil Chemists, presented to the Association of Agricultural Chemists a report of the work of the North American oil chemists for the improvement of the technique of food stuffs analyses. They had received samples of cotton-seed cake and cakes of other seeds in order conjointly to estimate the moisture content, and the ether, petroleum, and ammonia-soluble substances. At the present time, 75 collaborators are engaged in this work. At frequent intervals, samples are sent to them for analysis, and they communicate their findings to the Association by which the averages of all the data are obtained and sent to the various collaborators. On the second day, the President gave a lecture

describing the work and the responsibilities of the Government Agricultural Chemists.

Congress Commemorating the Fifty year's Anniversary of the Agricultural Stations and Agricultural Laboratories of Belgium. — This Congress was held in Brussels on May 17, 1923, under the patronage of a Committee presided over by the Minister of Agriculture, and composed of the representatives of the Agricultural Services, and of the chief, agricultural and scientific Institutes, as well as of those of the various industries connected with agriculture. The Congress included two sections: 1) Agricultural research; 2) Control of raw materials and agricultural products and repression of frauds. Secretary: J. GRAFTIAG, Boulevard de Diest, 113, Louvain (Belgium).

Congress of Algerian Tobacco Planters. — Held on June 5, 1923, at the Office of the "Confédération générale des Agriculteurs d'Algérie", 1 Boulevard de la République, Algiers. It was attended by over 200 tobacco planters, the Co-operatives of Bona, Kabylia, El-Afron and the Boufarik Syndicate of Tobacco Planters being largely represented. The following questions were discussed: 1) The right of entry of foreign tobacco in leaf-form; 2) Results of the Customs Union with Tunisia; 3) Improvements in the cultivation, drying and fermentation of Algerian tobaccos; 4) Formation of a Co-operative Society of tobacco planters for the foreign sale of leaf-tobacco; 5) Contracts with the Revenue Office. (*Revue agricole de l'Afrique du Nord*, No. 202, June, 15, 1923).

Organisation of the "Comité National du Blé" in France. — The members of the Congress of the National Wheat and Bread Week, decided before separating to form an inter-professional executive Committee to carry into effect the resolutions passed at the Congress.

This Committee has now been appointed under the name of "Comité central du blé et du pain". It has decided to establish wheat and bread Committees in every Department and, in order to facilitate communications between the Department Committee, it has been decided to unite the Departments into regional groups arranged according to the consensus of the different trades in such a manner that each group contains Departments producing similar if not the same, types of wheat.

Exhibitions and Meetings.

International Exhibition of the Pasteur Centenary, Strasburg, June-October 1923. — Includes the following sections: Scientific and Applied Hygiene — Science — Industries — Dwellings — Food — Agriculture.

International Piscicultural Exhibition, Leeds, England, September 24-October 6, 1923. — Inaugurated by the Universal Exhibitions Ltd. 22-24 Great Portland St., London W. C.

International Exhibition of Woods and the Wood Industry. Lyons, October 6-21, 1923. — This forms part of the Lyons Fair. For further information, apply to: Hotel de Ville de Lyon, France.

Special Show of the Tarantais Breed of Cattle at the Savoy Departmental Agricultural show at Saint-Jean-de-Maurienne, Octo-

ber 13-14, 1923. — Applications to be made before October 5, to the " Directeur des Services agricoles de la Savoie " 2 Place du Château, Chambéry.

IV French Competition for the Cultivation of the Finest Ear of Wheat (1923). — This Competition was organised by the Bordeaux Press, and has been held every year from, and including, 1918. It is under the patronage of the Ministry of Agriculture, the Departmental Agricultural Office of the Gironde and other Bodies.

The objects of the Competition are: 1) to promote and popularise the practice of selecting the hardiest local varieties of wheat producing most grain and which have the highest milling and breadmaking yield, in order to obtain the maximum production of good bread per unit of surface; 2) to interest the youth of France in wheat cultivation.

The competition is open to all cereal growers in France. A special section is reserved for French students.

Each group must be gathered at harvest time from the healthiest stools bearing the best developed ears composed of the greatest number of spikelets regularly furnished with grain of best quality, and consist of 4 plants (2 at least being complete) bearing the finest ears in the field. A set of questions is sent to each competitor.

Classification of the Ears. — The Competition is divided into two parts: a provisional and a definitive test respectively. The first includes two classes: First class a) *Scientific Part*: A preliminary inspection of the ears will be made by the delegates of the Bordeaux scientific Societies (Société Linnéenne, Société de zoologie agricole, Société d'Agriculture, Société d'Horticulture) and of the State Stations appointed by the Ministry of Agriculture (Station agronomique, Station entomologique, Station de Pathologie végétale de Bordeaux). The objects of this examination are to determine the botanical character of the ears, to identify the variety scientifically, and to analyse the grain, in order to ascertain its industrial value, in short, to obtain the data for drawing up the form to be presented to the judges.

b) *Technical part*: After the ears have thus been investigated, a mixed commission of agriculturists, corn-dealers and millers will give marks for cultivation and industrial classification, these taken together will classify the ears provisionally, and confer the right to an encouragement prize.

c) *Second class Selection*: From every group of plants, 4 of the best ears shall be removed by the mixed Commission; one of these ears is to be returned to the competitor for cultivation, the second is to be given to M. Rachel SÉVÉRIN (Technical Director of the Competition) to be grown at the same time in his experiment field; while the remainder are to remain as proofs with M. BRETHER, the organiser of the Competition.

d) *Selection cultivation*: Definite instructions shall be sent to each of the competitors to the effect that every single grain of the chosen ear shall be grown under the same conditions, the most fertile and hardiest of the resulting plants being noted.

Final Classification. — After the following harvest, the competitors shall present to the Commission the finest stools with the best ears obtained by selection cultivation. Their exhibits will be compared with the specimens ob-

tained in M. SÉVÉRIN's experiment field. If the result is favourable, the chosen grain is returned to the competitors to serve as a basis for seed-propagation.

The final classification is founded on the total number of marks obtained with two exhibits. The medal presented by the " Société Nationale de la Meunerie Française " shall be awarded every year to the variety of wheat finally classed as having the highest milling and bread-making qualities, since the chief object of the competition is to develop the good qualities of wheats capable of furnishing the largest amount of bread per surface unit.

Competitors are requested to attack to the best ears, specimens of the injurious plants that have invaded and infested the crops during 1923, in the districts where the said ears were grown.

Entries to be sent to the Société Linnéenne, Athénée Municipal, Salle 11, Rue des Trois-Conils 52, Bordeaux, and correspondence addressed to M. BRETHE 32, Rue de Lyon, Bordeaux.

Horticultural Exhibition, at Paris, October 26-November 5, 1923.

— This exhibition inaugurated by the " Société nationale d'Horticulture de France, " will be held at the Cours la Reine. Horticulturists, amateurs, gardeners, dealers in garden-produce, teachers of horticulture, Directors of Botanic Gardens etc. landscape gardeners and dealers in gardening material, who wish to take part in this Exhibition should communicate, before September 26, with the Président de la Société National d'Horticulture de France, Rue de Grenelle, 84, Paris. The regulations and programme are published in the *Journal d'Horticulture*, Series 4, Vol. 24, p. 91. Paris, March 1923

Prize of 200 Francs for the Finest Onion (Improved Rocambole). —

The competition will be held at the show arranged by the " Société nationale d'Horticulture de France, " in October-November 1923. The competition is for the best lot of 3, or 4, Rocambole-Amélioré (var. Aryan) onions and is open to all amateurs, horticulturists etc. One prize will be awarded by the Show judges. The entire plant with roots must be forwarded.

Exhibition of Food Products, Amsterdam, Holland, November 22-December 5, 1923.

Exhibition of Sugar Beet Seed, Paris, 1922. — The " Commission des graines de betterave a sucre " of the French Ministry of Agriculture has decided to inaugurate an exhibition of sugar beet seeds which is to be held in Paris in 1924, on the occasion of the General Agricultural Show. The exhibition will include: Chemical and physical apparatus for selection, apparatus for sorting and drying the seed, exhibits of firms engaged in selection, diagrams showing production etc. There will be lectures, and a cinematograph.

The Cruise of the " Terre de France ". — The exhibition ships, " Terre de France, " began her first cruise in April. She sailed from Havre and touched at Lisbon, Casablanca, Madeira, Dakar, Buenos Ayres, Montevideo, Santos, Rio de Janeiro, Bahia, Pernambuco, Port of Spain, La Guayra, Port-au-Prince, Havannah, Vera Cruz, New Orleans, Philadelphia, New York, Boston, Quebec and Montreal, remaining 4 to 15 days in each port. The cruise will last 8 months. The ship (20 000 tons), is fitted with stands and show-cases and provided with exhibition halls and refreshment rooms, reception rooms and a cinematograph. Sales with immediate delivery are effected on board.

Military Competition for Agricultural Tractors in France, 1923.—

The resistance test to which heavy and light tractors for the military competition of 1923 are subjected may be summarised as follows. The agricultural tractors must be of such construction that they can be used for horse-drawn artillery material up to a weight of 4000 kg. in the case of heavy tractors, and up to 1600 kg. in that of light tractors, especially on fairly light soil, or ground that has been torn up by shell-fire, etc. The maximum weight of the tractor, without the driver, shall be respectively 3700 and 2500 kg. The speed shall range from 6 km. per hour on good ground, to 1.5 km. on slopes not exceeding 20 % in the case of heavy tractor, and 30 % in that of light tractors. The average consumption per kilometre-ton (reckoned on an entire run of 40 km. on fairly diversified ground) of a tractor hauling a wheeled load about 4 tons in the case a heavy tractor and 1.6 ton in that of a light tractor, should never exceed 3 decilitres (motor oil or benzine) or 35 centilitres (motor spirit with 50 % of benzine). In short, the supply of fuel, lubricating oil and water shall be sufficient to enable the machine to work for 8 hours without replenishing. (*Le phosphate et les engrais chimiques*, Year XXXII, No. 1373, Paris, 1923.

The "Automobile Club de France" Competition for Explosion Engines.— In 1923, the field trials will take place in the South-West area. Communications to be addressed to the Marquis de Vogüé (President of the "Commissione agricole de l'Automobile Club de France") 8 Place de la Concorde, Paris.

Hay-Binder Competition in France.— A Hay-binder Competition will be arranged for 1923, or should this prove impossible, for 1924, by the "Syndicat des agriculteurs de la Manche" under the auspices of the "Office agricole régional du Nord", and of the "Office départemental de la Manche". The organisers request the constructors to enter a machine with a maximum width of 2.40 m. for animal tractor (by 1 or 2 horses) capable of binding into bales or loose bundles of about 5 to 10 kg. the hay lying on the ground, or collected into swathes. Other things being equal, preference will be given to machines binding bales, or bundles, weighing 5 kg. or less. For further information, apply to the "Syndicat des Agriculteurs", 1 Route de Lessay, Cointanées, or else to the "Direction des Services agricoles de la Manche, Saint-Lô".

First National Exhibition of Cheese Industries and Trades will be held at Milan in November, 1923.

Competition for Wines from Hybrid Vines in France.— In some districts, of France, exhibitions of wines from hybrid vines have been organised. The "Société d'Agriculture de Mâcon" held its fourth competition for such wines in January 1923; more than 250 samples from 14 Departments were entered. After the exhibition organised at Toulouse by the "Syndicat agricole de la Haute-Garonne" the President of the Syndicate himself drew up an exhaustive report giving the remarks of the judges with regard to the 367 samples presented and ending with the following words: "This report will show vine growers that the wine-making value of a large number of hybrids is undoubted. Hybrid wines exist from which perfectly palatable wine can be made, it remains for the vine-growers to choose the varieties that best suit their special

conditions. We do not, however, consider our task finished, for it will only gradually be possible to bring forward the most notable hybrid vines and the wines made from them, but we have every hope of succeeding in determining the best varieties and thus relieving vine-growers from the labour entailed by the copious irrigation required by the *viniferae*".

The President points out that it has again been proved that the same hybrids do not give equally good results in different localities. (*Journal d'Agriculture pratique*, March 31, 1923).

Travelling Exhibition in France. — The Paris-Orléans Railway has organised, in conjunction with the "Comité de la Semaine nationale du Blé", a series of travelling exhibitions of the best varieties of cereal seed. Three large railway carriages specially arranged for the purpose make the round of the Central Departments. The visitors will be shown the culms, ears and grain of the most productive varieties, and will be given information respecting the characteristics of these varieties, the improvements to be introduced into cereal cultivation and the method of laying out experiment fields for the comparative study of the selected and the local varieties.

In order to intensify poultry and bee production, as well as to encourage the trade in farm-yard produce and honey, the same Company has begun to send round, in several departments, vans containing poultry-yard and apiary material, and the species of poultry that it is advisable to rear. Thus, from February 22, to March 2, two large-sized vans containing various types of implements and accessories, as well as wall-diagrams showing the natural history and method of rearing bees, will stop at the different Departments of Finisterre, Morbihan and Loire-Inférieure to allow bee-keepers, to visit the exhibition. The Company is studying the question of organising travelling exhibitions for the products of other branches of agriculture.

Agricultural Exhibition at Rheims. — The "Comice agricole" of Rheims has organised, for the first time since the war, an exhibition of live-stock and agricultural implements and products. The exhibition was held in June 1923, and proved that the reconstruction work, at all events as far as soil cultivation concerned, is almost finished in the Department of Marne.

General Exhibition of Breeding Stock at Paris. — The "Concours général d'animaux reproducteurs" organised by the French Ministry of Agriculture was held in June 1923, in the Champ-de-Mars, at Paris. The exhibition catalogue gives the number of cattle, sheep and swine entered as 245 without counting the animals sent by the Breed Syndicates of different districts. The animals exhibited included: 648 cattle — 203 rams and lots of ewes — 71 swine — 7 milch-goats — 21 sheep-dogs. The number of cows entered for the milk and butter competition was 99. The cinematograph installed in the Exhibition court proved a great success. (*Journal d'Agriculture pratique*, June 6, 1923).

Competition of Viticultural Machines in France. — The "Comité d'Agriculture de Beaune et de Viticulture de la Côte-d'Or", has inaugurated trials for machines used in vineyard cultivation. For information as to results, apply to M. Chapot, Professor of Agriculture at Beaune, Côte-d'Or.

Exhibition of Agricultural Material at the Paris Fair. — This was held from May 10 to 25, 1923 shortly after the exhibition of the "Salon

de la machine agricole". It gave visitors the opportunity of seeing the machines in motion. The following new machines were exhibited: 1) *Cultivating machines*: motor-plough "motocharrue piocheuse" -- vineyard motor-plough MALLY system -- "Quadrill" planter and seed-drill for hoed crops -- automatic grindstone for sharpening scythes; 2) *Machines for preparing grain*: small threshers -- thresher attached to strawstacker -- threshers with OLIVS grain-stoker -- automatic sheller; 3) *Engines, etc.* LAW electric engine: -- apparatus for electric ploughing -- automatic electric pump -- "Sylvia" saw for trimming trunks -- "Fleus" electric and explosion engines-economical petroleum engines -- heavy oil engines -- "Listia" gasogene; 4) *Pumps, machines and various implements.*

Egg-Laying Competitions in India. -- The first egg-laying competition in India was held in 1920-21 by the United Provinces Poultry Association and proved such a success that it was decided to hold a similar competition every year. The first and second competitions were both limited to the 3 winter months. At the first, the winning hen was a Light Sussex which laid 65 eggs in 92 days. Eighty hens took part in the second competition and laid a total of 3320 eggs. (*The Agricultural Journal*, Vol. XVII, Part V, pp. 483-488, Calcutta, 1922.)

Exhibition of Agricultural Machines at Brno, Czecho-Slovakia. -- held from August 5-15, 1923; all the factories of agricultural machines in Czecho-Slovakia sent exhibits.

Miscellaneous.

Information Bureau for the Belgian Congo. -- "The Service des conférences et informations", Brussels, Rue de Buysbroeck 28, which supplements the "Office colonial", supplies general information on the Belgian Congo. It organises exhibitions, lectures and cinematograph representations of colonial scenes, lends negative and films, and supplies propaganda literature dealing with the Belgian Congo.

The American Forestry Association. at a meeting of its Directors held on April 24, 1923, accepted the proposal of the National Conservation Association to enter the Forestry Association of the United States. The amalgamation was to enter into effect from June 1. (*American Forestry*, Vol. 29, No. 354, Washington, 1923).

The World's Record of Milk Production was broken by Aggie, a Holstein-Friesian cow belonging to M. D. U. Hnemink of Cedar Grove (Wisconsin, U. S.). Aggie was sired by a Holstein bull whose ancestors had been carefully selected for producing milk with a high fat content.

Sowing by Aeroplane. -- Sowing from an aeroplane has been carried out in California, where in the neighbourhood of Lake Tulare, the soil is excessively damp and cannot be worked at the sowing season, which makes it very difficult to carry out seeding in the ordinary manner. Finally, an aviator flying at a height of 15 m. succeeded in scattering 360 kg. of seed over 6.5 hectares of this land. The seeds went deep enough into the soil to insure germination. The cost of this method of sowing is estimated at 2.5 dollars per hectare. (*Cerealia*, March 6, 1923.)

Ticks. — The Bureau of Animal Industry of the Department of Agriculture of the United States has circulated a film entitled "Mollie of Pine Grove Vat" which is to assist in the control of ticks affecting livestock! It will first be shown in the tick infested zones of the Southern States (by the help of a motorear), after which the film will be sent round according to the system of distribution adopted by the Department. (*The Official Record, U. S. Department of Agriculture*, Vol. II, No. 14, Washington, 1923).

Declarations of Origin for the Protection of French Viticulture. — The law of May 6, 1919, passed for the defence of French wines and for the repression of frauds connected therewith confers a special legal status upon declarations of origin. It was very well-received by wine-producers, so that since 1920, 12 000 declarations of origin have been registered, Numerous complaints have been made, and many sentences have been passed in accordance with the said law. The types of wine which have been defined and settled are: Chablis (Grand vin de Chablis, Chablis-Village-Supérieur, Chablis-Village) — Montrachet — Champagne — Saint Emilion — Sauternes — Monbazillac — Montravel (Haut-Montravel, Côtes Montravel, Montravel) — Bourgogne, Beaujolas, Mâconnais (Bourgogne, Beaujolais, Mâcon et Mâconnais, Côte Chalonaise, Pouilly). (*Revue de Viticulture*, March 1, 1923).

Enquiry on "Bramble-Leaf" of the Vine in France. — The "Société Départementale d'encouragement à l'agriculture de Hérault" has decided to open a general enquiry into the character and extension of the disease of the vine known as "bramble-leaf" (*arricciamento*), "court-noué") and of the results so far obtained from the various control measures that have been tried (1). The enquiry will be made by means of a questionnaire sent to those interested. Any one having a communication to make on the subject can obtain the form from the Head Office of the Society, Montpellier, Rue Durand, 19.

The Afforestation of Uncultivated Land in France. — In addition to her forests and woodlands, France possesses over 4 million hectares of uncultivated land. M. Chéron, the Minister of Agriculture, has shown in one of his circulars the advisability of planting this land with trees. The Administration of Waters and Forests makes grants in kind (seeds and young trees), and in certain cases, in money, to private individuals undertaking afforestation operations of public utility upon uncultivated land. These subsidies which are paid out of the Budget funds are supplemented by moneys allocated to the purpose under the provisions of the law of July 31, 1920. The grants, which often cover a large part of the total cost of the work, are a great encouragement to the afforestation of waste land. (*Journal d'Agriculture pratique*, No. 15, April 1923).

Stock-Breeding and the Agricultural Offices in France. — Ever since their foundation, the "Offices agricoles" have greatly contributed to the improvement of the French breeds of stock. In the financial year 1921, these offices used about 10 million of their balance in the purchase of selected breeding animals, the reconstruction of herd-books, the retaining of the best parents, etc. This work was continued in 1922. To mention one instance, the "Office agricole régional de l'Est" spent 75 000 francs for the encouragement of

(1) See *R.* 1919, No. 933. (*Ed.*)

Breed Syndicates of Black Pied Cattle; this amount was in addition to the far more important grants made by the Departmental Offices of the region.

Seed Control in France. — The Committee for Seed Control which was instituted at the French Ministry of Agriculture by the Decree of December 5, 1922, met on February 2, 1923. It has defined the manner in which an analytic catalogue of the existing varieties of seed is to be made and has requested M. RABATÉ to study a registration scheme for selected plants, to record the names of persons who have obtained, or discovered, a new species, or a new fixed variety of wheat. The Committee have decided that in future, only those varieties that have not been put on the market may be regarded as being new. Selectionists desirous of having new varieties entered on the Register of Selected Plants should apply to the Minister of Agriculture (Office des Renseignements Agricoles", Paris, Rue de Varenne, 78) according to the provisions of the Decree of December 5, 1922. Finally the Committee examine and discussed the text of the draught of a decree intended to protect purchasers of seeds from abuse. The work of the Committee is confined exclusively to wheat.

Proprietary Rights in Horticulture. — These are much discussed in France with the result that the "Office National de la Propriété horticole, with office, registers and forms ready for use have been established. New plants are registered by the General-Secretaries of the special Societies (Fruit Chrysanthemum — Rose) and by the "Société Nationale d'Horticulture de France", in the case of ornamental plants, flowers, and kitchen-garden plants (*Revue Horticole*, Year 95, No. 16, Paris 1923).

Terms Force and Power, Abbreviation HP. — One of the resolutions passed by the French Syndical Chamber of the Gas, and Petroleum Engines and Gasogenes Industry at its meeting on March 14, 1923 which should be recorded is the following: It is necessary to draw the attention of our members to the mistake they make in their use of the abbreviation H. P. (Horse Power). The English term H. P. represents about 76 kilogrammes. Since the French power unit is 75 kg., it is incorrect to use this abbreviation which represents a force of about one kg. more than the French unit. It is necessary to realise the trouble that the erroneous term H. P. may cause the constructors, and to substitute for it the French term "cheval-vapeur" and the abbreviation C. V. corresponding to a weight unit of 75 kg.

The Secretary has been instructed to notify this decision to the schools, the Syndical Chambers interested in motor-power, and to the technical press. (*Le Génie Civil*, Vol. LXXXIII, No. 15, p. 364. Paris, 1923).

Agricultural Electrical Cooperatives in France. — In the Department of Oise, 5 Agricultural Electrical Co-operatives with over 4700 members and a single Central Office at Compiègne were organised in 1920. The advantages of applying electricity to agriculture were demonstrated at a meeting held at that city on March 26. The object of the meeting was to determine, by a visit to the electrical works of the Compiègne district, how far it was possible to adopt this system and the effect it would have upon the sale of the energy of the rural electrical system. The visits paid to 3 electrical works showed that the system worked perfectly, excellent ploughing to a depth of 35 cm. being effected by a three-shared plough handled by only

two men; further, although the transverse trenches are very narrow they are not destroyed, and the cost of ploughing is relatively low. (*Journal d'Agriculture pratique*, April 14, 1923).

The Cinematograph in the Country Districts of France. — From the funds set apart by the law of August 5, 1920, for the purpose of agricultural instruction, the French Ministry of Agriculture is able to make grants for the construction, or purchase, of films of agricultural interest, or for the installation and working, in the rural Communes, or Institutes for agricultural instruction coming under the law of August 2, 1918, of cinematograph apparatus whether fixed or movable intended for the popularisation of knowledge useful to agriculture, or for agricultural propaganda. (*La Vie agricole et rurale*, April 14, 1923).

Teaching by Means of the Cinematograph in France. — At the present time, it is possible for the sum of 1500-2500 francs to purchase a lantern for schools, or small halls, and capable of throwing the image in a screen 2 to 2.5 m. wide sufficient for a hall containing 200 or 300 people. The price of hiring educational and agricultural films at the present time is 4 centimes per metre and representation, or 10 centimes a metre per week. Hence, the hire of a film of 100 to 200 metres, that takes 5 to 10 minutes to show on the screen, 4 to 8 francs for one representation, and 10 to 20 francs for one week. The following are the titles of some of Messrs Pathé and Gaumont's films. The Crossing of Wheat — Mimicry — Karyokinesis in a Living Cell — The Germination of a Pollen Grain — The Vintage, etc. (*Revue de Viticulture*, March 1, 1923).

The Draught Horse of Maine (France). — A Syndicate of breeders has been formed in the Department of Sarthe for the purpose of starting a Stud-Book for the draught-horse of Maine (Percheron type). The Office of the Syndicate is at Mans. (*Journal d'Agriculture pratique*, No. 8, 1923).

Vosges Cattle Breed of Alsace. — The Agricultural Director of the General Commission decided to start a State Herd-book for the Vosges Cattle of Alsace in 1922. The article gives the distinctive characters of the breed as determined for the Herd-book. Animals will be registered on the basis of: pedigree — shows — filiation. The Pedigree-book will be closed on December 31, 1925. (*Journal d'Agriculture pratique*, Year 86, Vol. II, No. 51, pp. 523-534, Paris, 1922).

Herd-book of Flemish Cattle in France. — Opened in 1921; in February 1923, by means of the Regional or Departmental Commissions, a thousand cows and some 200 bulls were registered. For further information, apply to the Secrétaire du Herd-book Flamand, 3, Rue Saint-Bernard, Lille.

The Adoption of Ploughs in Madagascar. — The Director of the Experiment Station of Namisana states that increasing use of the plough is made by the natives in the plain of Betsimitatatra, more than 100 000 hectares of rice-field being ploughed. Hence, the work of the Society, which has been ably seconded by the Administration of the Colony, has been successful. (*Les Cahiers coloniaux*, No. 230, Marseilles, 1923).

The Control of Agricultural Produce on the Ivory Coast and in French Togo. — The Grand-Bassam Chamber of Commerce has passed a local bill instituting an Inspection Service to protect the kernels of the oil

palm, palm oil and cacao from fraud or adulteration. The bill states the conditions under which this control is to be effected, and the penalties to be inflicted in the case of infringement. (*Bulletin des Matières grasses de l'Institut colonial de Marseille*, No. 1, 1923).

Aberdeen-Angus Herd-book. — The 47th volume of this herd-book has been published, it consists of 600 pages and contains the genealogical-tree of 2638 bulls and 2365 cows and gives the descent of the calves for two generations (*Live Stock Journal*, Vol. XCVII, No. 3251, pp. 186. London, 1923).

Rural Telephones in Great Britain. — The Post-Master-General has announced that between May 1, 1922 and March 13, 1923, about 3100 new subscribers to the rural telephones have been registered, 85 Central Stations and 650 telephone Offices have been established, while many others are in course of construction.

British Government Station for the Disinfection of Wool. — The British Government has passed the Anthrax Prevention Act and according to its provisions has opened in Love Lane, near Liverpool, a Station for wool disinfection. Dating from 1921, wool and all animal skins coming from the East Indies must be disinfected. The Station began working in June 1921.

In March 1922, disinfection tests were made with Ultra-violet rays and X-rays which permit of the disinfection being effected without the bales being undone; the tests gave good results. (*Chemistry and Industry*, March 2, 1923).

Field-Drainage Works as a Remedy for Unemployment in Country Districts of Great Britain. — The Ministry of Agriculture of Great Britain passed on March 9, 1923, 469 schemes for field drainage in various districts throughout the country, as well as 110 schemes for water-supply, which should contribute to the decrease in unemployment in rural districts. On February 24, over 6000 men were engaged in these works.

The Small Land-Holding in Great Britain. — In accordance with the "Land Settlement Scheme", small land holdings have been handed over to ex-Service men and others in England and Wales 1422 holdings have already been assigned, but have not yet been taken possession of, as they are not cleared. (*The Journal of the Ministry of Agriculture*, Vol. XXX, No. 1, London, 1923).

Exportation of Birds from Australia. — In the Congress of the Australasian Ornithological Union lately held at Adelaide, South Australia, the question of the exportation of live birds from Australia was discussed and the following resolutions passed: 1) No Australian birds shall be exported for gain; 2) No birds threatened by extinction shall be exported; 3) No birds shall be exported without proper inspection; 4) that an Office shall be established for the inspection of such birds as it is necessary to export, or that are to be exchanged for scientific, or instructive purposes. The Staff of this Office shall consist of two representatives of the Ornithological Union of Australasia, and in addition: a) one representative of the Universities and of the Scientific Societies of every State of Australia; b) a representative of the Natural History Society and of the Society for the Protection of Animals; c) one Museum representative for every State. (*The Avicultural Magazine*, Vol. 1, No. 3. London, 1923).

The Canadian National Poultry Record Association has been officially recognised by the Ministry of Agriculture of Canada. The object of this Association is to register all hens that fulfil the following conditions: are of pure breed and true to type — are free from disqualifications — have laid during one year, under the control of an official egg-laying competition, at least 200 eggs weighing not less than 2 oz. (*The Agricultural Gazette of Canada*, Vol. X, No. 2, p. 165. Ottawa, 1923).

Silk-Worm Rearing in Greece. — It is stated in the *Economiste d'Athènes*, Year 2, No. 38, p. 541, that the Greek Government, in assigning land to Armenian refugees, will choose by preference ground best adapted to silk-worm breeding, in order to establish, by the help of these fugitives, a large Greek sericultural industry.

New Italian Stock-Breeding Periodicals. — *La vedella zootecnica*, Cremona, Editor: Prof. TORREGIANI. — *Il campo zootecnico e caseario*, organ of the "Istituto pratico di zootecnia e caseificio M. Solari", Cuneo; Editor: Dott. GIVUARI. — *La nuova veterinaria*, a monthly scientific review, Bologna; Editor: Prof. Alessandro LANFRANCHI. — *Il cavallo italiano*, Rome, dealing chiefly with Italian, Anglo-Oriental and Anglo-Arab riding-horses.

The "bambacella" of the Olive Tree in Tripolitania. — "R. Ufficio agrario" of Tripolitania has informed the International Institute of Agriculture in Rome that the "bambacella" (*Euphyllura olivina* Costa), has attacked the olive-yards of the Colony to a somewhat serious extent. This is mainly due to the South winds (Ghibli), being considerably later than usual and were unable to exercise their beneficial mechanical action which, in past years, had almost completely neutralised the action of the parasite, and made measures of control unnecessary.

Exportation of Eggs from Poland. — This amounted in 1922 to 2 500 000 dozen (as against 1 333 000 dozen in 1921). The eggs were mainly sent to England and Austria. By an arrangement entered into between the Polish Republic, Austria and Switzerland, the last two countries are to receive 10 % of the total number of eggs exported. (*Weather, Crops and Markets*, June 2, 1923).

Agrarian Bills of the Czeco-Slovakian Republic. — 1) *Bill for the abolition of fideicommissum.* The institution of fideicommissum dates in Czecho-Slovakia from 1763, although the first registrations date back to 1602 (fideicommissum of Lichtenstein). The object of this institution is to assure to a given family of the nobility an eminent social position and to reduce the number of large family country properties. According to the law of 1868, new fideicommissi can only be instituted by a special law. The new bill suggests the abolition of the fideicommissum and forbids the appointment of any other holders of the Office. Any person desirous of having the use of a fideicommissum must come to an agreement with three future claimants and with the Curator of the Fideicommissum as to the manner in which it is to be administered. The agreement has to be communicated to the Court dealing with these matters in order to have it ratified within 6 months. Should the parties fail to reach any agreement, the property

becomes the possession of the person who now enjoys it, and of the person who occupied the position of next legal heir.

2) *Bill for Encouraging and Protecting Plant Production.* The Czecho-Slovakian Ministry of Agriculture has drawn up a Bill for the protection of the crops which suffer much from diseases and pests. The following is a summary of its provisions. Selected plants are often crossed by the access of pollen from unselected plants cultivated in the neighbourhood of the Selection Stations. To avoid this the growing of plants capable of fertilising the selected individuals shall only be permitted within a certain distance, so as to afford protection to establishments engaged in the selection and improvement of agricultural plants.

Agriculturists cultivating and breeding selected seed in their farms pursuant to agreement with the Seed Selection Stations are obliged to use every precaution to prevent the original seeds from becoming contaminated.

The injuries caused by plant and animal enemies to rye in Czecho-Slovakia have been estimated at 20 % of the production viz., at 1 800 000 quintals of the value of 271 millions of Czecho-Slovakian crowns, those to barley at 15 % of the production, viz. 1350 000 crowns; those to wheat at 10 % (634 000 crowns); to potatoes at 30 % (20 million crowns); to sugar-beets 10 % (80 million crowns). Apart from the losses occasioned to fruit-cultivation and sylviculture (especially by *Lymantria monacha*), the annual losses caused in Czecho-Slovakia by the vegetable and animal enemies of cultivated plants reach a total of 1 500 million crowns. (Communicated by M. ANTONIN PROKES, *Agricultural Engineer, Secretary of the Ministry of Agriculture, Prague*).

Work of the Ministry of Agriculture of the Republic of Czecho-Slovakia for the Improvement of Domestic Animals. — Hitherto, stock-breeding has been regulated in various ways in the different countries of the Czecho-Slovakian Republic. The Ministry of Agriculture is now endeavouring to introduce swine, sheep and goats. A bill allowing stockbreeding to be regulated according to the different condition of the Republic by means of the decrees of the Ministry of Agriculture has been laid before the Chamber of Deputies. This law makes the use of selected male animals compulsory in stock-breeding. Special Commissions will be entrusted with the choice of breeding animals. The Communes are obliged by law to acquire, and keep at the public expense, select male animals for public Service. The Government is authorised to define the limits of the regions for the rearing of the different breeds.

The Ministry of Agriculture is trying to remove the necessity for importing elected bulls by means of itself establishing dépôts (or entrusting them to capable breeders), where improved breeds of native cattle can be reared and their milk yield tested, and by the formation of cooperative societies, or grazing farms (*i. e.* farms with 80 % arable land and 20 % pasture) for the raising of young cattle.

These farms are to be managed by the agricultural Cooperative Societies or the Chambers of Agriculture under the direction of the Ministry of Agriculture. Hitherto, there have been 8 grazing farms and 30 grazing cooperatives. The communal grazing grounds are very numerous. The Ministry

of Agriculture subsidises both the grazing farms and the grazing cooperatives, and is drawing up regulations for the stock-breeding industry : choice of animals, keeping herd-books, giving young animals to the breeders of improved stock etc. The last condition is necessary in order to obtain the State grants (Communicated by M. ANTONIN PROKES, *Agricultural Expert, Ministry of Agriculture, Prague*).

ORIGINAL ARTICLES

THE ORGANISATION OF THE CAMPAIGN AGAINST LOCUSTS IN FRENCH WEST AFRICA

(Official Communication).

The International Convention for the Organisation of Locust Control of October 31, 1920, of which the General Government of French West Africa is a signatory, was followed by a North-African agreement entered into, in accordance with Article 3 of the said Convention, between Egypt, Tripolitania, Tunisia, Morocco, Algeria and French West Africa. This agreement has served as a basis for the organisation in French West Africa of an Information Service under the conditions suggested by the General Government of Algeria which had initiated the movement.

The Service consists of a close network of observation posts established in Senegal, Mauritania, the Sudan, the Upper Volta and the Niger from which information is transmitted to the Service for the Protection of Crops of Algeria by means of the General Service of Agricultural Inspection at Dakar.

The work of the observation posts has been defined in each Colony by circulars.

In addition, the Administrators of the various districts of the Colonies have been supplied with special instructions as to the best means of co-operating in the destruction of Acridiidae.

INFORMATION COLLECTED.

Enquiry of 1919. — The locust question has always engaged the attention of the General Government of French West Africa, and in 1919, it was decided to institute a general enquiry throughout all the Colonies of the Union in order to obtain as concise and accurate information as possible respecting the migrations and life

of the insects, to serve as a guide for measures to be taken to control these pests. The data forwarded were as follows:

MAURITANIA. — *Years of the Invasions.* — Throughout the greater part of this territory, the locusts make their appearance every year, although their presence was reported for the first time in 1910 at Kiffa, and in 1914 at M'Bout. In Trarza, according to Sheikh Sidia, the locusts regularly appear for seven consecutive years and afterwards are absent for the same period of time; 1919 should be the end of one period of invasion.

Time of Year at which the Invasions Occur.

Generally the advent of the locust coincides with the rainy season (June-July), and the swarms continue to arrive until the winter-season (October). At M' Bout, Kiffa, Chinguetti and Atar, invasions have only been recorded in September and October.

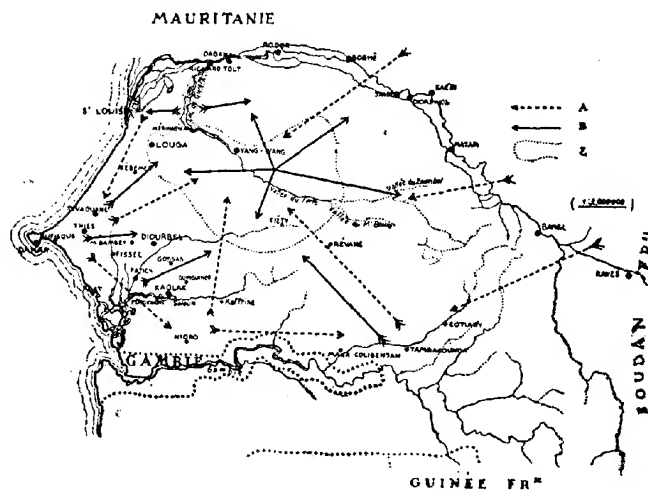


FIG. 91. — Invasion of Locusts in Senegal.

<i>Direction of Flight 1907-1917:</i>		<i>Season:</i>	
A	= Flight of 1st generation locusts.	1st generation:	2nd generation:
B	= Flight of 2nd generation locusts.	January-March	May-June.
Z	= Areas usually invaded for assembling and egg laying.	June-July.	November-December.

Direction of the Flight. — The general direction of the flight of locust swarms is N-E, S-W, though sometimes it is N-S. In Gorgol (Kaedi), the insects fly from West to East; in Adrar, they go from South to North, while at Port-Étienne they direct their course from the interior of the country to the sea in which many of the locusts are drowned.

Places selected for oviposition. — The locusts have been found to lay their eggs in all the districts except Assaba (M' Bout). Any soils are suitable for the purpose, but the insects show a preference for damp sand. The eggs are laid as soon as the first rains begin.

Return flights. — Returning swarms have been observed frequently in the different districts, and would appear to be entirely composed of pink insects in some cases, though in others, the two varieties, the yellow and the pink, occur.

The adult form and to a still greater extent the nymphs, do considerable damage to the crops and to the vegetation generally.

The destruction of the winged insects is a very difficult matter. The natives scare the locusts from their fields by shouting and making as much noise as possible with instruments and any object at hand, but they only succeed in frightening away some of the smaller swarms.

The nymphs are controlled by digging trenches in front of their serried ranks and burying the insects as they fall in. Unfortunately, most of the locusts are hatched in the vast uninhabited tracts of Mauritania, so that the measures taken at some isolated spots do little to decrease the danger of invasion.

SENEGAL. — In 1907, an invasion of locusts took place here and the enquiry made at the time is the first documentary evidence of any value dealing with this subject.

From the information collected it would appear that the earliest invasion occurred at L. L. in 1853, but not until 1892, was there any correlation found in the data furnished by the natives. From the latter source we obtain the following information :

Years	Districts Invaded
1892.	Bakel, Matam, Sine-Saloum.
1893.	Casamance.
1894.	Podor.
1895.	Casamance.
1899.	Podor.

Years	Districts Invaded
1900.	Bakel, Matam, Podor, Dagana, Nianiouli.
1901.	Casamance and Podor.
1902.	Casamance.
1903.	Casamance.
1904.	Podor.
1906.	Casamance, Podor, Dagana, Tivaouane, Sine-Salou.
1907.	Casamance, Bakel, Matam, Saldé, Podor, Dagana, Louga, Sine-Saloum.
1908.	Saldé, Podor, Louga, Thiès.
1915.	Podor, Dagana, Louga, Tivaouane, Thiès, Diourbel, Sine-Saloum, Nianiouli.
1916.	Matam, Saldé, Podor, Dagana, Louga, Tivaouane, Thiès, Diourbel, Sine-Saloum.
1917.	Bakel, Matam, Saldé, Dagana, Louga, Tivaouane, Diourbel, Sine-Saloum.
1918.	Podor, Dagana, Louga, Tivaouane, Thiès, Sine-Saloum, Upper-Gambia.

The directions of flight given in the replies to the 1919 enquiry were as follows :

Invasion 1906-1907.

Date	Locality	Direction
February 1906 . . .	Dagana	East
August 1906 . . .	Podor	W. N. W.
November 1906 . . .	Sine-Saloum . . .	North
November 1906 . . .	Tivaouane	East
January 1907 . . .	Louga	East
March 1907 . . .	Sine-Saloum . . .	N. W.
April 1907 . . .	Saldé	N. W.
May 1907 . . .	Bakel	East
May 1907 . . .	Batam	North-East
May 1907 . . .	Sine-Saloum . . .	South

1908 *Invasion.*

Date	Locality	Direction
April	Saldé	South
June	Matam	N. W.
September	Podor	N. N. W.
»	Dagana	North
»	Louga	N. N. E.
»	Thiès	N. N. E.
»	Tivaouene *	N. N. E.
October	»	N. N. E.
November	»	N. N. E.
»	Thiès	N. E.

The invasions of locusts were not afterwards recorded until 1915-1916; the swarms were very numerous both in 1917 and 1918. The course taken by the insects is given in the appended map.

In 1915-1916, numerous swarms of locusts arrived from the North and North-East; they crossed Senegal at various points between Bakel and Dagana directing their flight to the Ferlo and Djoloff, some taking the direct route past Matam and Louga and the others skirting Louga as far as the Gambia and turning up afterwards towards the Ferlo.

At the end of the wintering season, swarms of young locusts invaded the whole Colony being carried towards the North by the dominant winds. They were recorded everywhere from Sine-Saloum to the river which they crossed and then directed their flight again to the North-East.

In 1917, their course was observed to be almost the same:

Month	Localities	Direction
January 1917 . . .	Thiès (red locusts) . . .	N. W.
February	» (») . . .	South
March	Sine-Saloum	S. W.
June	Dagana (yellow locusts) . .	N. W.
August	Louga	N. and N. W.
September	Louga	N. W.

Month	Localities	Direction
September	Tivaouane	N. E.
"	Thiès	"
"	Matam	North
"	Saldé	"
October	Dagana	"
November	Bakel	East
"	Sine-Saloum	S. W.
December	" "	"

In 1918.

January	Dagana (red locusts). . .	N. W.-S. S.
July	Dagana (young locusts) .	N. W.-S. E.
"	Baol	N. W.-S. E.
August	Louga	N. W.-S. E.
"	Thiès	N. S.
"	Tivaouane	N. N. W.-S. S. E.
October	Podor (red locusts). . .	W. E.-N. N. E.
"	Dagana (" "). . .	W. E.
December	Upper Gambia	N. S.

(See fig. 91, page 824).

SUDAN. — Dates of Invasion. — Great damage has been done by "Sauterelles pélerines" (*Schistocerca tatarica*) at different localities in the Colony every year since 1897 inclusive, except in 1903-1904, 1905, 1911-1912 and 1913.

The *Schistocerca* nymph does the most injury, but from 1899 to 1902, a great deal of mischief was also caused by the grey locust (*Pachytylus migratoroides*).

Season of Invasion and Direction of Flight.

— The *Schistocerca* nymphs arrive at Hodh from the regions of the Sahara in the red, or yellow, stage, in June, or July, as soon as the rains begin. The insects mate and lay their eggs shortly after arrival and the larvae hatch out and spread over the Sahara zone in every direction.

If the number of locusts is very large, as it was from 1906 to 1909 inclusive, and again from 1914 to 1918 inclusive, the swarms reach the districts of Kayes-Nioro and Nara between July and October.

The sandy character of the soil in the Sahara zone, together with the moderate rainfall, appear to be favourable to the spread of the *Schistocerca* nymphs, whereas their progress is arrested in the Sudan district, along a line that varies according to the season, by the heavy rainfall and excessive damp.

From the Sahel, the insect normally extends its ravages eastward, and either crosses the bend of the Niger, or follows the valley of that river. These nymphs swarm in the Gao district from August to September, or from January to February, and at the latter season, some of the bands resume their flight towards the Sahara by the way of Wady Telemsi and Adrar Iforas, while the others continue their course in the direction of the Tchad.

During the first part of the dry season, the swarms sometimes make their way far towards the south, but they then do little harm to the crops, either because the harvest is ended, or because the wild vegetation provides them with sufficient food. As soon as the soil becomes too dry and hard to allow of oviposition, which occurs about December, the insects again taken wing towards the north.

Localities for Egg-Laying. — The locust has only been observed to lay normally in the Sahalian zone and the districts of Nema, Nioro, Niafunké, Goudam, Timbuctoo and Gao.

The swarms alight at night, for this is the time for oviposition. Incubation lasts from two to three weeks, and the insect is able to fly in forty to sixty days after it is hatched.

Return Flights. — Swarms of locusts proceeding Northwards are seen in Hodh from October to February.

Pachytylus migratorioides, which is more feared in some of the southern districts than *Schistocerca tatarica*, has not been reported since 1902. According to local tradition the swarms of this Acridian start from the Manding Plateau.

NIGER. — **The Dates of the Invasion.** — All the documents consulted, and the data given on this subject by the natives agree that, until towards the end of last century there had never been, throughout the whole territory, any large invasions of locusts that had destroyed the crops. Every year, a small black locust used to come from the East in October, but it flew over the millet fields without touching the grain and alighted on trees, date-palms by preference, and devoured the leaves. This species has now disappeared.

About thirty years ago, probably in 1890, the first invasion of

grey locusts with pinkish-yellow abdomens took place. They came both from the North and the East, and over ran the whole territory, doing considerable damage. Since that time, no single year has passed without swarms of locusts, which while they were insignificant in size in the vicinity of the Niger, the district of Niamey being relatively little attacked, increased in dimensions and density as they passed eastwards.

Season and Direction of the Invasions. — As regards the time and direction of the invasions, it seems that the Military Territory of the Niger may be divided into three well-defined zones where the season of the arrival of the locusts and the course of their flight are quite different. These zones are :

a) In the East, the region included between the Territory of Tchad and a N-S line following approximately the meridian of the 10th degree of east longitude.

b) In the West, a strip of territory about 100 km. wide and parallel to the river.

c) In the Centre, the region included between the two preceding zones and forming the greater part of the Territory.

A. — Eastern Region. — The swarms that reach this district are the largest in the Territory. They arrive during the winter and generally come from the East. Thus, in Bilma, they are reported in January as coming from the East, or occasionally from the North. Most of the swarms arriving at N'Guigmi come from the East in November, although a few smaller bands have been reported in July. Numerous swarms from the Tchad invade Mainé-Soros every winter, one especially large swarm was recorded in February 19, 1919.

All these bands of locusts interrupt their flight towards the West when they reach the neighbourhood of the 10th meridian, or more exactly on the western limit of the vegetation of the Oases, which traces a curve towards the West as it passes towards the cultivated regions of the South. No swarm has ever been reported at this season flying in the direction of Gouré, or northwards to Agadez. We shall, however, meet with these locusts again in the paragraphs dealing with egg-laying and the return flights of the insects.

B. — Western Region. — The district of Niamey, which lies on the extreme limit of the territory, is the goal of many small swarms that annually make their way thither from every quarter in February and March. Those swarms that are composed

of grey locusts with pink abdomens, arrive at a time when there are no crops, or grass, to be found, so the insects gradually disperse in all directions and disappear as soon as the heat sets in without reforming into swarms. Thus from the point of view of "migrations" the river district clearly does not belong to the same category as the Eastern district of the territory.

The invasion of 1890 was especially destructive in the region of Niamey. It took place in May, for the first rains hatched out the eggs that had been laid by the locusts in the sand, and for six or seven years, the country suffered from fresh broods of innumerable nymphs that appeared annually. At last, however, the pests disappeared and from that time, the riverine district was free from the nymphs and only troubled by the swarms of adult insects mentioned above.

Central Region. — This region as we have delimited it, forms the largest part of the Territory, and suffers from two annual invasions of locusts one occurring before, and the other after, the rainy season.

The first swarms arrive in May and June; they come from the North-West of Azaouak, a district North-West of the Tahoua-Agades line. Some of the swarms stop between Tessaous and Madaoua (to these we shall return in the paragraph dealing with oviposition), but the larger number continue their course to Tassaoua and then turn due East by way of Zinder. This invasion is short, for the locusts (which are grey with pink or light yellow abdomens) only stay one or two days and mate, since they find nothing but the leaves of the trees to eat. In the neighbourhood of Gouré, a few bands turn aside to the South-East in the direction of Mainé-Soro and Nigeria, but most of the swarms fly North-East to the limits of the vegetation of the Oasis on the 10° of East longitude where the bands reported from Bilma and N'Guigmi have already halted three months earlier and to which region they seem to be irresistably attracted.

The second invasion takes place immediately after the end of the rainy season and follows an exactly opposite course to that adopted by the preceding invasion, the swarms starting from the edges of the oases where the first-comers had stayed their flight. It is, however, a new invasion, for the locusts composing these swarms are generally smaller than those that passed three months earlier and most of them have brilliant pink, almost red, abdomens, so that

it can be no question of the returning bands of the first invaders. The swarms reach Gouré in September, and are seen in October, at Zinder and Tessaoua.

This second invasion is much the most dreaded, for at this season an uninterrupted stretch of crops, mostly of ripe millet, extends from the Tchad to the Niger. The locusts which fly in such dense clouds as sometimes to give the impression that an eclipse of the sun is in progress, alight on the millet fields and devour an enormous amount of grain as compared with their size. The natives declare that many of the insects fall victims to their greediness and are found clinging to the ears of millet, dead from over-feeding.

West of Tessaoua, the swarms take their flight in two directions, but finally meet at the same point. Some of them turn towards the north arriving at Agades in October, and on coming into contact of the Massif of the Air, sheer off westward towards the Azaouak. The others continue their westerly course past Madoua and Tahoua, and when they arrive at the Massif of the Ader, fly north in the direction of Azaouak.

The region of Agades and the Massif of the Air adjoin the central region which is annually exposed to the two invasions, to which allusion has just been made. The neighbourhood of Agades escapes the first invasion, for the locusts pass to the South-West, but on the other hand, at the time of the second invasion, many nymphs that have hatched out a few months previously in the district of Air and have gradually descended the southern slopes of the Massif, ravage the meagre, sparsely-sown crops of that area. These swarms meet the others returning southwards, mingle with them, and disappear with them in Azaouak.

The latter place thus appears to be a meeting centre at the end of October and early in November, for all the swarms of locusts in the Central region on their way east after the rains. What becomes of these bands? They ought to be met with at Hogger. If they go North-west, they would be reported in winter from the district of Gao and Adrer or Iforas; perhaps some of the flocks continue their course to the west and south-west, in which case, the locusts found in February at Niamey may belong to these swarms that have been weakened and reduced in numbers by their long winter flight.

The natives, however, assert, without adducing any proofs that these insects pass the winter in Azaouak where the rocky plateau pierced with numerous deep caves would afford them shelter

from the cold. If this be the case, these locusts may well form the swarms which take part in the first invasion and descend again next year, in May towards Zinder, but we possess no certain data in confirmation of this hypothesis. The problem can only be solved by seeing these bands join forces with the migrating swarms found in the Timbuctoo district and on the Hoggar massif.

Oviposition. — The best known localities of oviposition in the Territory, and certainly those where the locusts lay most eggs, are situated on the western limit of the vegetation of the Oases between the line running North and South from Bilma to N'Guigmi and the meridian of the 10th degree of East longitude. The swarms from Bilma and N'Guigmi come hither in January and February to lay their eggs and are successively followed by those from Zinder and Gouré which, however, do not arrive until June.

Another favourite place for oviposition is the district lying between Madaoua and Tessaoua on the northern limit of the cultivated land. Here, some of the swarms stop in May on their flight from Azaouak.

A third area of oviposition has been also reported in the Air massif, but nothing is known as to the origin of the swarms that frequent it.

It is generally assumed that the first rains make the eggs hatch out. According to the natives, the eggs may remain for two years in the sand if there is no rain to moisten them. A fortnight after heavy rain, the ground is covered with countless nymphs that have emerged from the egg-clusters. Three weeks subsequently to their appearance on the surface of the soil, the insects are able to jump short distances, and a week later, they can fly a little. After another fortnight they are capable of undertaking long flights.

There is certainly one exception to the general rule according to which the action of rain is necessary for the hatching of the locusts' eggs. In the Oasis of Bilma, it hardly ever rains, indeed, rainless periods lasting several years almost invariably occur, yet it is to this very region, situated on the line where the cultivated land borders on the desert, that the largest numbers of locust swarms come to lay their eggs, while the nymphs hatch out every year and wend their way southwards. This apparent anomaly may possibly be explained as follows:

At the base of the rocky cliffs forming the eastern boundary of the region in question, there flows a subterranean stream which

comes from the north and seems to go past Bilma and Agadez in the direction of the Tchad. Although this stream runs at a depth of one metre at Agades, it is almost on a level with the ground at Bilma where the locusts deposit their eggs. In June, the sand is saturated with water, and as it gradually becomes heated by the sun, so much water is given off by evaporation that the few centimetres of sand between the stream and the air, in which stratum the eggs have been deposited, becomes damp and therefore the eggs readily hatch out. Thus, the same result is obtained as from the rain, but the moisture reaches the eggs from a different direction.

Return Flights. — The returning swarms mentioned by the district Governors are few in number.

It has been reported from Bilma that some of the swarms coming from the east in January returned to that quarter in February, but nothing was said as to whether oviposition has been effected in a normal manner. It was, however, stated that the number of these returning bands is very small in comparison with that of the outward bound swarms.

At Agades, some of those locusts coming from the north which we have already spoken of, are occasionally seen in October to unite together into large swarms and direct their course to Azaouak. These returning locusts are so thin that they are worth little as an article of food; the expedition to Ténéré did not prove a success and for the above reason was a great disappointment to the natives.

What part do the return swarms play in the the second invasion that crosses the central region of the Territory? This is most difficult to determine, but it is certainly very insignificant since the greater number of the locusts that come subsequently to the first invasion, die after they have laid their eggs on the soil, which is impregnated with salt, or natron, for the scanty vegetation offers the locusts no sustenance, and the ground is sometimes covered with their dead bodies. The few individuals that survive go back probably with the nymphs, but there are no data showing the number that actually survive.

Further, it may well be that the many large grey locusts which we mentioned above as being found dead, clinging to the millet ears, were old insects that had undertaken the task of guiding the young swarms and had succumbed to age, and not to greediness.

If this explanation is correct, and it is true that the locusts winter in Azaouak, we could now trace out the complete cycle of which

we spoke earlier: the insects hatch near Bilmé in the summer, migrate towards the West in the autumn, winter in Azaouak returning in the beginning of summer to the neighbourhood of their hatching-place where they propagate their species and then die. In this case, they would traverse a thousand kilometres.

But even if these suggestions are taken as proved, we should only have a partial solution of the problem for the whole question of the migrations remains almost untouched. What is the complete



FIG. 92.

I-XI = months of year.
H = wintering.
P = laying of eggs.

course of the swarms reaching Bilma and N'Guigmi in winter from the East. Whence come the locusts that lay their eggs in Aïr, and those that arrive at Niamey from all directions in February?

As we foreshadowed at the beginning of this article, nothing but a thorough study of the Acrididi, carried out over the whole of Africa, would render it possible to fix the principles and determine the general rules governing the migrations of locusts. This paper can only form a small contribution to the study of the question (see fig. 92). The information collected is, however, a valuable help in the attainment of the object aimed at by each of the Governments forming a party to the agreement for the control of locusts.

Observations from 1922-1923. — The telegraphic information transmitted to Algiers arrived in the following chronological order :

May	31, 1922,	swarm reported from M' Bout.			
November	2, 1922,	swarm reported from M' Bout.			
»	24	»	»	»	Nioro coming from the south-east and flying north-east.
»	25	»	»	»	Niamey coming from the east and heading south.
December	3	»	»	»	Néma (west of this place)
»	4	»	»	»	Niamey coming from the south-east and going north-west.
»	31	»	»	»	Tillabéry coming from the east and flying north.
January	1, 1923	»	»	»	Tillabéry coming from the east and going south
»	2	»	»	»	Niamey, coming from N. N. W. and going south-east.
»	12	»	»	»	Kiffa.
»	15	»	»	»	Tillabéry coming from the east and flying west.
»	21	»	»	»	Kiffa, 2 km. to the north.
February	12	»	»	»	72 km. W. S. W. of Nara a portion of a large swarm reported from Ngalabougo.
March	5	»	»	»	Niamey.
»	11	»	»	»	El-Oualadji.
»	20	»	»	»	Barouéli coming from North-east and flying eastward.
	29	»	»	»	Dogondoutchi.

April	6	1922,	swarm	reported	from	Barouéli	and	El-Ouala-
						dji.		
May	5	"	"	"	"	Dogondoutchi.		
"	26	"	"	"	"	Niamey	passing	north.
"	27	"	"	"	"	Niamey	passing	north-
						east.		
"	28	"	"	"	"	Niamey	passing	east.

GENERAL GOVERNMENT OF FRENCH W. AFRICA

Inspector General of Agriculture.

FURTHER PROGRESS IN THE IMPROVEMENT OF ARABLE LAND

As a result of the development of agronomic science and of the progress made in the experimental field of plant physiology, many new ideas as to the best means of increasing agricultural production have gradually arisen. At the present time, it is certain that the increase in the living vegetable matter of our agricultural products can only be attained by a thorough knowledge of the biochemical nature of the soil and of the chemical energy of the plant cell. The problem is of paramount and world-wide importance, but in France especially it would be possible to increase the crops of wheat, beetroots and potatoes, an immense advantage to the national revenue, since the agricultural products of that country are valued at thousands of millions of francs.

The distinguished scientists of the preceding century gave their attention to soil physics and chemistry, but the more recent revelations of science have shown that the soil is inhabited by various organisms which play a large part in plant nutrition. It was PASTEUR who, last century, drew attention to the great importance of the micro-organisms in the soil, but unfortunately, the signal service rendered by his genius in this direction was not sufficiently recognised.

The work of the soil bacteria was only realised when the great discoveries of the celebrated scientist BERTHELOT, resulting from his first experiments at Meudon in the assimilation of free nitrogen, and the studies made by WINOGRADSKI, DUCLAUX, MAZÉ, LAURENT, SCHLOESING, BEIJERINK and others on the circulation of nitrogen in the soil threw a new light on the important function of these indispensable microorganisms.

HELLRIEGEL and WILLFAHRTS' discovery of the synergy of the bacteria present in leguminosae and of algae, and the exhaustive studies of HILTNER and NOBEL suddenly enlarged our knowledge of the facts connected with the assimilation of atmospheric nitrogen.

GARON, a farmer of Ellenbech, had however been engaged in working out the problem of the importance of soil bacteria as factors

effecting the vital processes of plant life, and the fruit of his long labours was the discovery that arable land could be inoculated with soil bacteria capable of assimilating atmospheric nitrogen. He adopted this inoculation process in the case of fields to be sown with wheat.

The writer of the present article, on his return from the Pasteur Institute thirty years ago, gave much attention to this question, and strongly advocated the idea of inoculating arable soil, as is shown by his published works on this subject and the numerous lectures given at Paris, Nantes, Grenoble, Rome, Berlin, Vienna and Cracow.

Unfortunately, but little heed was paid to the ideas of PASTEUR and of BERTHELOT, indeed, it is only after many years of experiment in many countries, especially in America, that it has been realised how important is the work of these small living organisms which, by the changes they produce in substances and in energy, exert such an enormous influence upon the fertility of the land as to make it impossible to disregard their activity.

No agriculturist can now deny that the work of these bacteria is one of the most important factors in determining the fertility of the soil. We, ourselves, have found the weight of the bacteria present in a soil layer of 40 cm. extending over 1 hectare of fertile arable land to be from 200 to 400 kg., while that of the other living organisms ranged from 800 to 1000 kg.

The following groups of organisms live in arable land and are very active agents in promoting its fertility:

- | | |
|-----------------|------------------|
| 1) bacteria | 8) enchytracides |
| 2) fungi | 9) tardigrades |
| 3) algae | 10) spiders |
| 4) protozoa | 11) insects |
| 5) rotifers | 12) molluscs |
| 6) oligochaetes | 13) mammals. |
| 7) nematodes | |

All these organisms that inhabit the soil require for their support oxygen, hydrogen, carbon, nitrogen, phosphorus, sulphur, chlorine, potassium, sodium, lime, magnesium, aluminium, iron and manganese. In the case of the heterotrophic forms, it is necessary that the carbon should be present in an organic form, and for the same reason,

organic substances are of paramount importance to the existence of the bacteria and fungi of the soil.

The oxygen and water in the soil play a special part in connection with all the living organisms, which have frequently almost to contend with one another in order to secure the amount of water necessary to their well-being.

Since no organisms can live without water, the determination of the water capacity as well as of the air capacity of a soil is the basis of biochemical experiment.

In order to know exactly the proportions of the aerobic and anaerobic organisms, it is necessary to determine the amount of carbon dioxide and oxygen present in the soil.

Oxygen is indispensable to metabolism and to the functioning of the radicle system of the plant. If the oxygen content of the soil falls, however, the processes of assimilation continue normally, even when the amount of oxygen is small, and intermolecular respiration may take place in the radicle system.

Further, the reaction of the soil greatly influences the biological processes occurring in it, hence this factor deserves serious attention, not only from the purely physiological standpoint, but also from the phytopathological point of view.

The hydrogen-ion concentration of a soil has a great influence upon its chemical and biological absorption. Neutral and alkaline soils absorb nutritive substances more readily than those with an acid reaction. In order to judge of the biochemical processes in progress in a soil, the colloidal substances present must be determined. The value that is of most interest to the biochemist is the degree of dispersion which determines the area of the active surface. Biologically speaking, the colloidal content is the most decisive factor, and the colonies of bacteria must not only be taken into account, but also other groups of organisms. Of these the principal are the actinomycetes, and different species of fungi and algae. The quantity of micro-organisms varies considerably according to the kind of soil and the extent to which it has been worked. By far the larger number are found in a layer varying in depth from 10 to 25 cm.; below 40 cm., their number decreases rapidly, and at a still greater depth, there are relatively few.

In order to better illustrate this, the number of micro-organisms is given which were found in 1 gm. of dry soil taken from a layer 10 to 20 cm. deep.

In a rye field	30 to	43 million
In an oat field ,	28 "	45 "
In a barley field	42 "	58 "
In a beet field	70 "	90 "
In a potato field	42 "	45 "
In a clover field	72 "	86 "
In a lucerne field	80 "	120 "
In good garden mould		130 "

It must, however, be mentioned that the above figures refer to soil samples taken after the crops had been carried at the beginning of August. The data obtained show that the largest quantities of bacteria occurred in the fields where sugar-beets and clover, or lucerne, had been grown and in good garden mould. Most of them were the rod-like forms, cocci being rarer. The number of fungi found was somewhat small. Ordinary forest soil contains fewer micro-organisms, 15 to 26 million being present in 1 gm. of a dry sample taken from a layer 20 cm. in depth, and only 5 to 9 million in the case of acid soil.

The composition of the microflora, of which nothing has been known until now, has a great effect in maintaining the fertility of the soil.

All these micro-organisms require, in addition to oxygen and water, certain quantities of nitrogen, carbon, phosphorus, potassium, magnesium, iron, and sometimes of aluminium, in easily assimilable forms.

According to our experiments, they contain 40 to 50 % of carbon which would seem to show that they need larger amounts of carbon than of the other substances.

Different kinds of micro-organisms find their home in the soil, the following groups of bacteria being represented :

1) bacteria which, like green plants, need not be supplied with sources of carbon dioxide or of nitrogen. These autotrophic bacteria can obtain for themselves carbohydrates, as well as albuminoid substances, carbon dioxide and inorganic salts ;

2) bacteria needing sources of organic carbon, but independent of nitrogenous substances, as they can obtain all the latter they require in the presence of carbon, atmospheric nitrogen, nitric and ammoniacal nitrogen ;

3) bacteria which, like animals, require sources of organic car-

ben, and obtain their nitrogen from nitrogenous compounds. They cannot produce inorganic substances, nor effect the synthesis of carbohydrates, neither can they form the albuminoids present in living cells.

Bacteria and fungi find in the organic matters of the soil :

- 1) substances for the building up of new living matter ;
- 2) the substances they require for respiration.

The amount of carbon dioxide liberated in 1 kg. of soil at the same temperature and moisture content and with free circulation of air, affords an indication of the relative respiration intensity of the autotrophic and heterotrophic micro-organisms present in different soils. The quantity of carbon dioxide given out under these conditions shows the vital energy of the bacteria and their power of breaking up the organic substances in the soil.

In organic matter, the bacteria not only find a source of the energy necessary for respiration, but also a rich store of carbon and nitrogen, for the formation of new living matter.

The writer was the first to discover the origin of the large amount of carbon dioxide in the soil and its great importance. This he did as early as 1905, as a result of numerous experiments. He also laid stress upon the large quantity of carbon dioxide produced by the soil bacteria.

For several years, the writer has studied the intensity of the respiration process in the auto and heterotrophic micro-organisms living in the soils of our fields, meadows, forests and gardens. This work has shown the intensity of the process to vary enormously and to depend upon the following factors :

- 1) the air and water capacity of the soil,
- 2) number of active autotrophic and heterotrophic forms,
- 3) intensity of oxidation and of breaking-down processes,
- 4) soils power of splitting up cellulose,
- 5) chemical reaction of soil,
- 6) mechanical cultivation,
- 7) kind of fertiliser used,
- 8) species of plants grown.

The writer gives the following numerical data obtained in the course of his long investigations, which will serve to show how the respiration intensity of micro-organisms in the soil is a criterion of the fertility of the land.

The respiration intensity of the autotrophic and heterotrophic micro-organisms present in 1 kg. of soil containing 20 % of water, and kept under aerobic conditions for 24 hours at 20°C. has a certain relation to the bacteria in the soil.

The following amounts of carbon dioxide have been found in 1 kg. of dry soil :

Average in soil free from organic substances	8.14	mgm.
Meadow soils.	10.16	"
Forest soils poor in organic matter	9.12	"
Forest soils rich in organic matter	16.26	"
Poor rye and oats soils	19.25	"
Good rye and oats soils	30.36	"
Good wheat soils	30.48	"
Good clover soils	53.60	"
Good sugar-beet soils	56.68	"
Good garden mould	62.75	"

Carbon dioxide production falls rapidly as the depth of the soil increases, thus only traces of the CO₂ resulting from respiration are met with 50 cm. below the surface. The liberation of a large amount of this gas is evidence, not only of the presence in the soil of much easily-destroyed organic matter, but also of the presence of actively working bacteria.

It should be remembered that these quantities of carbon dioxide given off by respiration in 24 hours represent the average for 20 days.

Distinct differences can be detected in the intensity of the respiration of the soil micro-organisms. These variations depend, as we have seen, on certain factors, and especially upon the number, kind, and activity of the bacteria, as well as upon the nature of the organic substances in the soil.

Supposing that the micro-organisms in 1 kg. of arable soil from a layer 26 cm. deep were only to produce 30 mgm. of carbon dioxide in 24 hours, the amount of this gas evolved by the micro-organisms in a mass of clayey soil weighing 5 000 000 kg. (the average weight of a layer 36 cm. deep spread over 1 hectare), would be 150 kg. per day which, if we only reckon at 200 days the time when the annual temperature attains the average of 15°C., would mean a liberation of 15 000 000 litres of CO₂ every year. The large quantities of this gas

expired by these bacteria help to form mellow soils, especially those of the more friable types. These figures leave no doubt as to the large part played by the respiration of micro-organisms in the formation of the carbon dioxide in the soil. One fact is especially interesting in this connection viz., the respiration of the micro-organisms present in a soil layer 10 to 30 cm. deep raises the temperature of the soil from 1° to 2°C. This is of the greatest importance, since such a rise in temperature represents 4 to 8 million calories per hectare.

In soil that has been altered to this extent, the carbon dioxide absorbed by the groundwater transforms the bi- tri- and tetraphosphates slowly, but surely, into water-soluble phosphoric acid.

It is also very necessary that the cations should be changed in the soil into bicarbonates; in the formation of the latter is to be found the true importance of the above-mentioned carbon dioxide problem.

These bi-carbonates also form nutritive substances which promote the metabolism of the plants, also, they are easily absorbed by the root system, especially in the presence of carbon dioxide and are carried to the organs containing chlorophyll.

The plant finds in the soil, not only biogenetic elements like potassium, calcium, magnesium, iron and aluminium in the form of bicarbonate, but also carbon. Green plants assimilate carbon dioxide from the atmosphere by means of their aerial organs supplied with chlorophyll, while by the agency of their roots, they can obtain carbon from the bicarbonates of the soil thus, considerably increasing the chlorophyll function, raising it as much as 70 to 160 %, as we have found.

If the pressure of the air changes, the temperature increases, and the soil air containing carbon dioxide rises and comes in contact with lower surface of the leaves which is well provided with pores.

Low-growing plants are able to make more rapid and ready use of this stream of assimilating energy than trees. The old statement that green plants can obtain their necessary carbon only from the air is not true, for the roots are able to use the carbon present in an organic, or inorganic, form, in the soil, although the air still remains the chief sources of supply upon which the chlorophyll phenomena depend.

Our experiments have shown that when the CO_2 content of atmospheric air is 0.1 % the green mass of the crop is increased by organic synthesis. In ordinary air containing 0.04 % in volume of CO_2 , the whole weight of the beet rose to 120 gm. When the CO_2 content

reached 1 %, 2 % and 3 % the weight of the plant rose respectively to 224 gm., 258 gm. and 272 gm. Thus increasing the amount of CO_2 in the air progressively augments photosynthesis and metabolism, as well as contributing to the formation of fresh plant substance. The experiments were carried out for 38 days at the uniform temperature of 22°C. These facts prove that it is absolutely necessary to increase the production of carbon dioxide by bacteria.

Therefore we will investigate the soil on the one hand in order to determine the bacteria, or bacterial spores and the decomposing organic matter it contains, and on the other, with a view to determining the carbon dioxide production so as to have some basis upon which to work in trying to increase the output of CO_2 .

ORGANIC SYNTHESIS. — Carbon assimilation and the absorption of biological elements by the organisms of the sugar-beet proceed entirely according to certain mathematical laws. In the presence of different plant elements, and under ordinary conditions, the dry substance produced on 1 hectare of soil is 8000 kg. roots, and 4000 kg. leaves, or a total of 12 000 kg. of sugar-beets.

This dry matter includes 5,400 kg. of carbon. We found from our experiments that during the vegetative period, the organism of the beet, that is to say, the roots and leaves, gives off 4,280 kg. of carbon in the form of carbon dioxide; therefore the sugar-beet assimilates, under the influence of the solar rays, 9,680 kg. of carbon in the form of atmospheric carbon dioxide. The photosynthesis can be decidedly increased by CO_2 and radioactivity.

In order to accomplish this, it is necessary for 44 million cubic metres to pass through the pores of the leaves. We can now have some idea of the dynamics of photosynthesis. If one of the elements of the plant has its physiological function lessened by a decrease in the energy of the solar rays, or a variation in the amount of heat, moisture etc., the whole process of photosynthesis is correspondingly depressed.

The phenomena of the assimilation of atmospheric carbon dioxide and of the biogenetic elements in the soil take place in relative proportion.

The reabsorption of the biogenetic elements of the soil is carried out according to certain mathematical laws: 9680 kg. of carbon are assimilated in relation with 168 kg. nitrogen (N), 220 kg. potassium (K_2O), and 66 kg. phosphoric acid (P_2O_5). All the mechanism for the synthesis of the materials used in the construction of

the plant organism is regulated according to the results of the assimilation of CO_2 from the atmosphere, because all the biogenetic elements have a certain relation to the carbon assimilated, and the reabsorption of the mineral elements of the soil depends upon the intensity of the photosynthetic process and upon the composition of the carbohydrates, fats and albuminoids. Herein lies the solution of the great problem of the increased yield observed in the sugar-beet. By the application to the soil of a large number of biogenetic elements, phosphorus, nitrogen, potassium etc., in the form of chemical fertilisers, we have already obtained the best results obtainable by this means. If we desire to produce a still higher yield and improve the quality of the crop, we must so arrange that the organism has at its disposal more carbon in the form of carbon dioxide and this can only be done by increasing the biological activity of the soil to the point of making one kg. of dry soil produce 100-130 mgm. of CO_2 in 24 hours. In fact, all the best sugar-beet soils are characterised by intense biological activity and large production of carbon dioxide.

By a series of continuous experiments, we have succeeded in supplying the soil with certain quantities of nitrogen, phosphorus and potassium under forms that will unite to make easily-decomposed organic combinations containing a larger number of active bacteria.

These compounds are, *nitrogenous humus* and *phosphatic humus*. The latter contains 13 to 14 % water-soluble phosphoric acid, a larger proportion of organic matter and about 2 thousand million active bacteria per gm. Phosphatic humus is made with natural, crushed phosphate.

Fortunately for France, she possesses large quantities of various kinds of natural phosphates that are easily disintegrated by biological action. The powdered phosphate is mixed with prepared peat which is subsequently inoculated with cultures of bacteria, those species being selected that are found upon the root of the sugar-beet. These bacteria are cultivated artificially, and the whole culture is inoculated into the prepared peat which is in a colloidal condition. The mixture is then left to ferment for 15 days. The phosphatic humus thus obtained has been used with marked success as a substitute for superphosphate. Nitrogenous humus is made with calcium cyanamide, which is transformed by the action of the enzyme urease into ammonium carbonate. In the presence of carbon dioxide, bicarbonate of ammonium is formed.

The percentage of the fertilising substances present in nitrogenous humus is as follows:

Ammoniacal nitrogen	8:10 %
Organic matter	25:30 %

Nearly one thousand million active bacteria are found in 1 gm. Satisfactory experiments (to the total number of 320), have been made with this fertiliser at our State Experiment Station, as well as by the Agriculturists' Association of the Republic, the Brünn Regional Chambers of Agriculture, and at Prague. M. MAHNER (Councillor), M. SKARDE (engineer) and Dr. LIPSCHUTZ being chiefly interested in these tests. According to the published results, the crops were increased 55, 70 and 120 % by the application of 600 to 800 kg. of this biological fertiliser per hectare.

Nitrogenous and phosphatic humus have the same effect as dung and chemical fertilisers, but they produce higher yields. The bacteria of these humic fertilisers not only are more numerous than in dung, but they include species giving rise to a very beneficial fermentation action in the soil.

From all that has been said, it is clear that we actually have at hand the means of greatly increasing our agricultural crops, provided we keep in mind that free access of oxygen to the soil is necessary to insure proper fermentation.

In the experiments we have carried out with a soil that had been fertilised and inoculated with bacteria and was distinguished by great intensity of respiration, 1 kg. of air-dried soil producing up to 120 mgm. of CO₂ in 24 hours we succeeded in obtaining the following yields per hectare: 500 to 680 qx. of roots containing 18.4 % of sugar, and 246 to 319 qx. of leaves.

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THE NEW NITROGENOUS FERTILISERS OF GREAT BRITAIN

The new nitrogenous fertilisers were already known and studied to some extent in Great Britain even before the War, but they played no very great part in practical farming. In this there were two reasons. In the first place the British farmer relies very largely on livestock to supply his land with nitrogen. A large number of cattle, sheep and pigs are kept, and over most of the country the system of husbandry centres round the animals.

Before the War the following were the approximate quantities and values of the nitrogenous manures consumed in the United Kingdom :

	Tons per annum.	Estimated value per ann : Pre-War Prices
Farmyard Manure	37,000,000	£11,000,000
Nitrate of Soda	80,000	920,000
Sulphate of Ammonia	60,000	750,000
Cyanamide & Nitrate of Lime	10,000	110,000

In addition to the farmyard manure large quantities of animal fertiliser are added annually to the soil by means of sheep folding, a common practice on loams, sandy and chalky soils, in which sheep are penned on the arable land, eat the growing crop and receive in addition quantities of corn and cake. No good estimate can be made of the quantities of nitrogen thus added, but in the aggregate they are considerable.

This factor continues to operate and it remains true that nitrogen reaches the farm soil largely through the animals.

A second cause of the comparatively small part played by the new nitrogenous fertilisers in British agriculture before the War lay in the fact that the country is well supplied with coal, and that various coal-using industries, notably Gas Works, Coke Ovens, Producer Gas Plants and others, take steps to recover the ammonia produced. To some extent the manufacture of sulphate of ammonia is only incidental to the main business. The manufacturers can hardly help making it; they cannot destroy the ammonia nor discharge it into the atmosphere or the streams without involving themselves in breaches of the Alkali and other Acts.

When industry is going at full pace the normal output of 400 000 tons or so per annum becomes almost automatic. The result is that a large quantity of sulphate of ammonia is available on the British market, far in excess of what the farmer now uses, or indeed is likely to use, in any time in which we are interested. Much was exported, very largely to the sugar-producing countries and to Japan for rice cultivation. The figures, in long tons, were :

	1909	1910	1911	1912	1913
Production	233 664	367 587	384 976	388 308	432 618
Export	162 300	284 976	292 000	287 000	325 000
Home consumption	71 700	87 000	85 500	90 000	97 000

The greater part of the home consumption was for agriculture, but not all as other industries, such as refrigerating, etc., took their share, though the demand for such purposes does not appear to be increasing. During the War the figures rose and they reached a maximum in 1917.

Since the War the production of sulphate of ammonia in this country has fallen off : the figures are :

	1917	1918	1919	1920
Production	458 617	432 551	397 513	418 881
Home consumption	384 000	404 500	285 500	233 500
Used for fertiliser	230 000	234 000	269 000	

With a home production of sulphate of ammonia so far ahead of home requirements, and remembering also that the nitrate of soda industry is well organised in Great Britain, it is obvious that new nitrogenous fertilisers are likely to have some difficulty in establishing themselves on the British market.

There are, however, certain directions in which the new are able to compete successfully with the older fertilisers, and these will be considered under the various heads.

Nitrate of Lime.

This substance has been tested at a large number of centres and has usually proved as effective as nitrate of soda ; sometimes the one and sometimes the other has proved the better, but on an average the difference has been slight. The most extensive trials are those started before the War. Some typical results have been as follows :—

	Mangolds						
	Midland Agricultural College, Derby 1915 (1)		Gloucester				Reading 1909 (4) strong loam
			Cirencester (2)		Calcareous soil (3)		
	light soil	heavy soil	1909	1910			
	t. cwt.	t. cwt.	t. cwt.	t. cwt.	t. cwt.	t. cwt.	
Nitrate of soda . . .	29 8 1/2	30 14	29 14	32 4	25 11	34 18	
Nitrate of lime . . .	28 8	30 4 1/2	32 5	30 3	25 11	35 1	
No nitrogenous top- dressing.	20 10	25 18 1/2	23 14	28 0	21 19	23 3	

(1) *Midland Agricultural College, Derby, Reports 1915*, p. 51, 1909 and 1910, p. 33.

(2) *Royal Agricultural College, Cirencester*, 1910.

(3) *Gloucester Country Council Reports*, 1909 and 1910, p. 74. Table 1.

(4) *Reading University College, Department of Agriculture, Bulletin VII*, p. 11, 1909.

	Potatoes				Barley		Wheat	
	(1)	(2)	(3)	(4)	Rothamsted		Rothamsted	
	Woburn 1909 Sandy loam	Devon Light soil	Jersey (5 centres)	Aberdeen Various centres 1907-1909	1909		1910	
	tonscwt.	tonscwt.	lb. per perch	tonscwt.	Grain bushels	Straw lbs.	Grain bushels	Straw lbs.
Nitrate of soda	15 9	10 15	221	9 5	48.1	3882	27.0	3760
Nitrate of lime	15 6	10 7	228	9 6	46.2	4449	20.7	3618
No nitrogenous top-dressing	14 12	9 18	195	8 6	28.7	2619	15.4	1526

(1) *Journal of the Royal Agricultural Society*, London 1909, p. 385.

(2) *Devon Country Council Report*, 1907-1909, p. 6.

(3) *State of Jersey (USA) Field Experiments*, 1911, p. 2.

(4) *University of Aberdeen and North Scotland Leaflet* 9, p. 2.

In practice nitrate of lime still suffers somewhat from the disadvantage that it is apt to turn sticky in a moist atmosphere and that it must be conveyed in casks, a fact which necessarily adds to the cost of transport. Further, it is not suitable for the mixed or "compound" fertilisers which are very popular in Great Britain. It has, however, the great advantage of containing calcium in place of sodium, and is therefore of value in two sets of conditions in England.

1. — On heavy soils, since it does not cause the deflocculation and therefore the stickiness or "unkindliness" to use the farmers' phrase, which is often brought about by nitrate of soda.

2. — On soils deficient in lime, of which there are large areas in England, particularly in the west, where the calcium, small though it be in quantity, nevertheless proves of high value.

In the writer's view there is a distinct future for nitrate of lime in Great Britain, not in supplanting, but in supplementing, nitrate of soda and sulphate of ammonia.

Nitrate of Ammonia.

This substance became available for British farmers immediately the War was over, although in anticipation of the event the Rothamsted Experimental Station had made enquiries and experiments as to its probable value as fertiliser. Next to urea it is by far the most concentrated nitrogenous fertiliser on the market. When pure it contains 35 % of nitrogen, equivalent to $42\frac{1}{2}$ % of ammonia. Half of the nitrogen is in the form of nitrate which is immediately available for the needs of the crop, and the other half in the form of ammonia which comes into action somewhat later. Samples examined at Rothamsted have been about 96 % pure, the remainder being mainly moisture: in this case the nitrogen content is $33\frac{1}{2}$ %.

Further, as the ammonia is combined in the form of nitrate it has no exhausting effect on the lime in the soil, so that it can be used where there is a shortage of lime and where, therefore, there is reason to believe that sulphate of ammonia would not be wholly suitable. It is also entirely suitable for general farm crops and is perhaps the quickest-acting top-dressing known, being even more soluble than sodium nitrate, and at the same time, as part of its nitrogen is in the form of ammonia, it is not so liable to loss if wet weather sets in after it has been applied to the soil.

Like some other very soluble substances, ammonium nitrate is liable to attract moisture from the air, and some samples become unmanageable because they form a tough cake which cannot easily be broken and may become pasty. There are, however, several varieties or modifications of ammonium nitrate, and one of them is free from this objectionable property. It is obtained by recrystallising under special conditions. This non-deliquescent variety keeps quite well in a dry shed: some of it was stored in the manure shed at the Rothamsted farm for ten months without becoming unmanageable. But it is by no means clear that this result could always be obtained, or that sufficient of the non-deliquescent variety could with certainty be manufactured to meet the needs of farmers.

In the case of any fertiliser in England it is necessary to enquire how it would behave in admixture with others, partly because as already stated, farmers prefer to buy mixed or "compound" manures,

and partly because, even when they buy the several substances themselves, they prefer to put them on altogether as far as possible, in order to save labour, a very serious item on British farms where wages are much higher than in many parts of the Continent. In the case of nitrate of ammonia this question would not usually arise, as the proper use of this substance is as a top-dressing.

It was found, however, that should the necessity arise, nitrate of ammonia would quite well mix with superphosphate so long as this material was dry and in good condition, but that if damp, noxious brown fumes were given off, as might be anticipated.

As a top-dressing it had the defect in some instances of scorching the leaves of the young plants, particularly in the drier and warmer parts of the country. At Rothamsted a crop of mangolds was injured in this way in 1914, the small crystals falling on the leaves yielded so strong a solution that the plant suffered considerably. In later experiments the material was applied in a fine interval during showery weather, with the result that it was speedily washed off the leaves and caused no damage at any time. In experiments in the North, where the conditions are moister and cooler, no bad effects were observed.

The results of the experiments showed that nitrate of ammonia behaved very like nitrate of soda for farm crops: for example, for mangolds it was more effective than sulphate of ammonia when reckoned on an equal nitrogen basis, probably, because part of its nitrogen is already in the form of nitrate; for wheat it is equally effective. For potatoes, however, it is more risky than sulphate of ammonia: it gave as large a crop, but induced the formation of a large growth of haulm, which would be a disadvantage wherever there was much blight. The results at Rothamsted have been:

	Mangolds tons per acre	Potatoes tons per acre	Wheat			
			Grain bushels per acre		Total produce including straw lb. per acre	
			Expt. 1	Expt. 2	Expt. 1	Expt. 2
Basal dressing:						
+ Nitrate of Ammonia (1). . .	23.3	8.8	44.7	37.7	8120	7830
+ Sulphate of Ammonia (1). . .	18.6	8.7	41.3	40.1	8180	7775
+ No nitrogen	17.3	8.0	38.6	34.6	7310	7025

(1) Equal quantities of nitrogen are applied on these plots.

As compared with nitrate of soda it has sometimes proved more effective. Thus in an extensive series of twelve experiments on hay land, carried out by HENDRICK at Aberdeen, during the years 1911-1914 the results were as follows:—

	Cwt. of hay per acre.
Basal dressing Nitrate Ammonia (1)	56.2
» » Nitrate Soda (1)	53.8
» » No nitrogen	50.2

(1) Equal quantities of nitrogen are applied on these plots.

Similar results have been obtained with oats and also with mangolds. It is quite possible that nitrate of ammonia is really the most effective and most valuable nitrogenous manure we have. But as against this enormous advantage there is the serious risk of deliquescence, and until this is greatly reduced it is unlikely that nitrate of ammonia will find an important place in the market.

Urea.

Urea is the most concentrated of all nitrogen compounds offered to the farmer. It has not been the subject of many field experiments in England, but whenever tested as a fertiliser it has proved to be of the same order of value as sulphate of ammonia and nitrate of soda. The difference between these two fertilisers is in any case not very great. If the nitrogen in nitrate of soda is valued at 100 that of sulphate of ammonia is usually worth 96 to the farmer.

But in English farming it is always necessary to take account of possible harmful effects on the soil. Urea is singularly free from these; it does not make heavy soil sticky as nitrate of soda does, nor does it remove lime from the soil as does sulphate of ammonia. The writer knows of no soils on which urea would be unsuitable. It mixes with practically every fertiliser and would cause a minimum of trouble to the manufacturer of mixed fertilisers and proprietary manures. Further, it does not wash out from the soil, but is retained probably as well as sulphate of ammonia, in which respect it is superior to nitrate of soda which in very wet districts, is liable to wash out.

So far as present evidence goes, and it seems quite sound, urea is more effective when drilled with the seed than when used as top-dressing. The experimental results at Rothamsted have been:—

	Barley				Potatoes (1)
	1921		1922		1921
	Grain bushels per acre	Straw cwt. per acre	Grain bushels per acre	Straw cwt. per acre	tons per acre
Basal dressing:					
+ Urea	34.0	23.4	33.4	21.8	2.63
+ Sulphate of Ammonia	35.9	23.5	32.3	20.3	2.31
+ No nitrogen	26.1	17.6	25.2	16.8	2.00

(1) This crop almost failed because of the drought.

The high percentage of nitrogen in urea gives it a great advantage wherever transport is an important consideration. For the export trade, or for farms situated a long distance from rail or canal, or wherever a long railway journey has to be made, there is a considerable advantage in handling a manure containing 37 % of nitrogen as is the case with urea, rather than in handling one containing only about half this amount. Further, the freedom of urea from injurious secondary effects on the soil, to which reference has already been made, gives it special advantages wherever any such effects cause inconvenience to the farmer. If urea can be put on the English market at the same price per unit of nitrogen as sulphate of ammonia it will undoubtedly prove a serious competitor. Even if it remained somewhat dearer there still remain distinct possibilities for it in cases where the lime-removing effect of sulphate of ammonia could not satisfactorily be remedied, and where nitrate of soda was unsuitable, so long as the disparity of price was not too great.

Ammonium Chloride.

For technical reasons ammonium chloride is one of the cheapest forms in which synthetic nitrogen can be put on the market.

On general grounds it would be supposed that the chloride and sulphate of ammonia must be of equal value as fertilisers. There is, however, much physiological evidence to the effect that the chloride under certain conditions may be harmful to plant growth. It by no means follows that this would happen in practice; whether it would or not can be ascertained only by trial. In view of the technical importance of the salt an extended investigation is being made at Rothamsted and at various centres in England under Rothamsted supervision.

The investigation proceeds on two lines. Pot experiments are made to see whether the chlorine is exercising a harmful effect on the soil, or whether some of the soil constituents are mitigating, or even suppressing, the action.

Field experiments are made to discover to what extent field factors, — such as subsoil, varying water supply, or indirect effects of ammonium chloride on the soil itself — influence the action of the fertiliser.

The pot experiments show conclusively that the chlorine ion has no visible toxic effect on the plant in soil *when all conditions are favourable to growth*. The chlorine and the sulphate had at least equal value when compared on the basis of equal nitrogen content; indeed in the light soil the chloride usually proved the better.

Field experiments gave varying results. In many cases the chlorine proved inferior to the sulphate, especially under rather dry conditions: in other cases there was no recognisable difference between the salts; while in a few cases the chloride appeared to give better results than the sulphate. It may of course be the case that this apparent beneficial action is simply the usual "scattering" of field trial results; this will become clear when more data have accumulated. But when the results are set out in detail there is a distinct suggestion that, in certain conditions, the chloride does in fact give better results than the sulphate. What these are can as yet only be conjectured and it is more profitable to await the results of further experiments.

There is, however, one objection to ammonium chloride which in some conditions might prove serious as it appears to increase the risk of loss by drainage. This action is more harmful than that of ammonium sulphate which leads to loss of lime and consequent acidity, because in the case of the sulphate, the calcium compound is certainly not harmful to the growing plant, while calcium chloride is injurious. The harmful effect could no doubt be reduced to a minimum by proper attention to time and method of application, and indeed it is a possible cause of the occasional beneficial results that have been noted above.

The field results have varied with the season. The season 1921 was hot and very dry.

In this year the nitrogen in ammonium chloride had approximately the value of 90, when that in ammonium sulphate was put at 100.

The season 1922 was cold and wet. The nitrogen in ammonium chloride, when that of the ammonium sulphate was put at 100, had the following values:—

For potatoes in 56 tests	99
For mangolds in 18 tests	98
For cereals in 2 tests: Grain	99
Straw	105

The result is so near to 100 that it might at first be supposed that the ammonium chloride was fully equal to ammonium sulphate as fertiliser. Closer examination of the figures shows, however, that one or two results step out very much from the average and raise the value above its true level. When a distribution curve is drawn it is clear that the peak comes somewhere about 96-99, and for the present it is better to take this figure rather than the crude average as expressing the value of nitrogen in ammonium chloride when that in ammonium sulphate is put at 100.

Some of the individual results are as low as 83-88: these are invariably obtained with potatoes grown without dung and with kainit or potassium chloride. It is not usual to grow potatoes without dung, but if for any reason this were being done, it would apparently be inadvisable to use ammonium and potassium chlorides together as fertiliser.

It is at present difficult to say what future lies before ammonium chloride as fertiliser. Almost everything will turn on the price at which it can be sold: it is undoubtedly of great value to the farmer, and when its various effects on the soil and the plant have become better known it will be possible to set out the conditions under which it can be used to the maximum advantage.

Cyanamide.

It is perhaps hardly necessary to refer to cyanamide here since its direct action as fertiliser is not as good as that of the other substances to which reference has been made, and it can be converted by the manufacturer without great difficulty into one or other of them. There can be little doubt that this is the wisest procedure.

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*Director of the Rothamsted
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ELECTRO-SILAGE IN GERMANY

I.

- 1) Principles and aims of modern methods of preserving forage.
- 2) Tests of bacteriological and chemical processes in electrically preserved forage and the characteristics of electro-silage.
- 3) The action of the electric current and the possibilities of its economical use.

The depreciation of the currency in the Central European countries since the war has made impossible the importation of good quality forage in any quantity from districts where there is a surplus, and consequently these countries have found it increasingly necessary to make all possible use of their home grown forage by improved methods of ensilage. This is especially the case in those Alpine regions where precipitation is very high and rainfall distribution very unequal. The wet seasons of 1918 and 1922 resulted in several failures of the forage crops, and the shortage of hay, and in particular its dependence on weather conditions has brought into stronger relief the serious shortage of food stuffs and the unfavourable working conditions, due to the difficulties of the economic position.

Taking as a basis the experience already gained over a considerable period with the farm pit-silo, the American turret-silo and the stack-silo, the invention of the Herba-reform-silo in Switzerland in 1917 by Mossmer and Sonderegger (followed by several technical improvements in Germany) led to a rapid diffusion of the use of the silo, especially on medium-sized and large farms. The rapid progress made in the preservation of forage is marked by the following systems: Herba-Reformsilo, Switzerland: sweet silage experiments carried out by Gardner and Aurich, Dresden: Duplex turret-silo of the South German Fermented Silage Company (Garfuttergenossenschaft) Munich: and the Ila turret-silo of the «Industrie für Landwirtschaſt», a limited company, Munich.

The essential feature of the latter system is that the spontaneous generation of heat in the loosely packed forage can be checked at a temperature of about 50°C. by means of pressing apparatus.

Lactic acid fermentation in the forage is thereby encouraged, and the forage is thus impregnated with this product of metabasis. In this condition the silage keeps well, and will moreover fetch a good price, provided it is possible to prevent setting up any injurious processes, while its value as a feed is comparable to that of green forage. By this means green forage is practically available in winter, and hence milk production is increased. At the same time at a temperature of about 45° to 55° C. the lactic acid fermentation prevents injurious forms of decomposition such as the giving off of volatile, fatty acids (lactic and butyric acids), and the putrefaction of the albumen is avoided.

A comprehensive literature is now in existence, describing all the above methods with their advantages and disadvantages (see bibliography). They differ for the most part in technical details, permanent improvements having been introduced during the last few years in the pressing apparatus. Thus for small farms the *Herbasilo* with its horizontally fitted screw press (double chain) is indicated as the most suitable, while the Ila-turret-silo with its easily regulated piston apparatus appears to be the best for large farms.

Leaving out of account those advantages of ensilage which though of importance may now be regarded as indisputable (e. g. more assured profits, partial economy of plant substance, better distribution and economy of labour, increased production, the rapid clearing of fields making a succession of crops possible, economy of space, avoidance of risks of fire and insurance charges) silage methods may be compared from the economic standpoint by reference to the following main criteria of the general problem:

1. Economy of the sources of energy (sources of warmth, fuel).
2. Maintenance of the forage under conditions giving the highest possible nutrient value.
3. Production costs.

If these points are taken as the standard by which the existing methods of preserving forage are to be judged, it is obvious that if the price of conservation of energy is the expenditure of valuable plant substance, this is an uneconomical process. It is only in the modern compression processes that the losses are relatively insignificant. Generally speaking the loss of nutritive substances in hay amounts to 20 to 50 %, in sour forage 30 to 50 %, in forage compressed by the older methods 20 to 30 %, in modern silage 5 to 30 % and when the method of inoculation with pure lactic acid bacterial cultures is em-

ployed, 5 to 10 %. The percentages can even be reduced to 1 to 2 % in the electric ensilage processes still to be described.

There is moreover usually an element of uncertainty introduced, due more or less to weather conditions, the manipulation of unaccustomed and somewhat complicated processes, and finally to chance itself. Hence it is not surprising that the small farmer has kept to the old-fashioned use of dry hay and the newer compression methods have in the main been adopted on the larger farms only.

The whole question of ensilage has been placed on an entirely new basis, the full bearing of which it is not yet possible to estimate, by the discovery made a few years ago that by means of electric current a silage can be obtained which is not only in no way inferior to the silage produced by other methods, but possesses the important advantage, of allowing green forage to be harvested in wet weather without loss.

The manipulation of the electric silo is at the same time very simple and does not involve heavy working expenses. The practical experience gained in the last two years with the electric silo all goes to prove that if the instructions for working are carefully followed an excellent silage can be obtained from the greater number of the forage plants. Moreover, independence of weather conditions, one of the most important desiderata of the whole problem of ensilage, is also secured. Further experiments suggest that a wider and more important principle of the economic preservation of forage, the avoidance of expenditure of the plant substance itself as a source of energy will shortly be realized.

The credit of having discovered the electric method of ensilage and of having made it of practical use to agriculture, belongs to the agricultural scientist, Th. Schweizer, a Swiss by birth. The world-renowned firm of Siemens-Schuckert, Berlin, undertook the manufacture and formed a special "Elektrofuttergesellschaft" (Electric Silage Co.) in Dresden, Reichstrasse, 1. This company also undertakes the sale of the electric silo.

The countervailing drawbacks to the important advantages of the electrosilo are not very serious. Apart from the fact that it can be used only where electric current is available, the return on outlay taking into account the cost of the current is only ensured, if correspondingly large quantities of forage are treated and at the same time technical defects avoided. In the case of smaller farms it seems particularly advisable to make a careful estimate of costs and

returns, taking into consideration the capital outlay, the cost of the current and of working, the nature and quantity of the forage to be ensilaged, the existing demand, etc. In this connection it should be noted that when fodder is scarce, especially in wet seasons the saving of a single aftermath crop may cover the cost of the whole silo installation. Mention may here be made of the effect of electrically treated ensilage on the cheese-making properties of milk. According to the experimental tests of the research stations in Bern-Liebefeld (Switzerland) (1) and at Wangen (Allgau) milk yielded by cows fed on electric silage proved to be of no use for the manufacture of high priced soft cheeses (2). But by adding sour cream cultures to this milk all drawbacks as regards taste are avoided. All the so-called defects are thus of very little importance in comparison with the numerous advantages of the electric silo.

To sum up, it may be said that the present position as regards existing practical methods of ensilage is that the electrical conservation of green forage plants is of all the processes the one that has reached the highest technical perfection. It is possible by this process in almost any weather to make good silage of uniform quality with only a negligible loss in dry weight and no essential exhaustion of the valuable protein substances. Whether viewed quite generally or from the standpoint of the national economy the greatest importance attaches to the increase in the milk yield attained by the use of this silage. It is reckoned that the increase is 2 litres per cow per day. Hence all the more is it incumbent on science and technology to remove existing defects so as to ensure economy and a conservation that is in the fullest sense reliable. In particular every effort should be made to devise a process which reduces the electricity used both in point of time and of strength so as to save charges for current, and thus be within the means of the smallest farm. The current might well be used exclusively at night-time when it is cheaper, and a movable plant arranged by which several silos could be treated successively, and the desired reduction in expenses thus secured.

There seems every probability that the method will be generally adopted. Feeding with roughage would thus become the more general practice in winter, thus saving the expense of dearer feeds

(1) There is every reason to suppose that in Bern-Liebefeld the material used in the experiment was not the electrically prepared silage, but a sour silage containing butyric acid. The same is generally true as regards the chemical experiments made at the Higher Technical School at Zurich.

(2) See No. 784 of this *Review*. (Ed.)

and also the farmer with a small holding would have a silage plant for his home grown forage, of a simpler, more easily manipulated and economical type than those now in use.

Thus the scientific farmer would be in a position to procure winter silage for his stock, exactly as in every well regulated household it is taken for granted that provision will be made for the more costly winter needs by preserving fruit, making jam, etc. It should also be remembered that an outbreak of foot and mouth disease may often be checked by supplementary feeding with silage prepared electrically. Most probably other symptoms of oncoming disease, such as the licking habit in marshy districts could be controlled by this feed (1). These questions should form the subject of special investigations.

II.

In contrast with the satisfactory practical experience with the electrosilo, and the definite need for cheapening and improving it, there is only a very slight knowledge of the influence of the electric current on the actual condition of the forage. This is due to the fact that in the treatment of the forage by industrial electric currents a new discovery is being made, the full explanation of which is still far from being clear to science. From the technical standpoint the electrosilo had its predecessor in a preserving apparatus used for fruit, jam making, etc. which was invented some years ago. The physiological aspect of the processes induced in plant substances by electric energy is completely unknown, although the important modern investigations in the chemistry of physical processes make it certain that electricity has a direct influence not only on the molecular but also on the atomic energy of plants and that fixed laws govern this influence (quantum theory, theory of electrons). No deeper insight into the physical processes as they appear in electric ensilage will be possible within any measurable span of time, seeing that we possess no sense organ for electricity nor any means or apparatus, by which we can accurately perceive and register its action.

The problem as to the action of the current is therefore pre-eminently one for the research worker.

It can thus be readily understood that exact scientific results in regard to the conservation of forage by means of the electric cur-

(1) See No. 677 of this *Review*. (Ed.)

rent are only very meagre. On the technical side pioneer work has been done in recent years by the highly developed German industries. As to our knowledge of the chemical principles underlying the silage problem no essential advance has been made, and the only names connected with modern research into the problem of electric conservation are those of VÖLTZ, FINGERLING and M. SCHULZE (1). No work has as yet been done in connection with the interesting and important biological questions of the electrical sterilization as occurring in silage. Only quite recently Prof. SCHEUNERT and Dr. SCHIEBLICH in Berlin have begun to investigate electric silage and almost at the same time Councillor Prof. KINSEL and the present writer started experiments at the Bavarian *Landesanstalt für Pflanzenbau und Pflanzenschutz* (Agricultural Institute for Plant Culture and Protection), Munich. The following is a brief account of the results of the experimental work at the Bavarian *Landesanstalt*.

The first care of the experimenters in their search for practical results was to make a close examination and study of every phenomenon that appeared to be the immediate result of the electric treatment. Up to the present there have been no bases for a comprehension of the action of the electrosilo, and the existence of the most diverse theories is therefore easily explicable.

It is maintained by silo experts that the bacteria cannot be killed by the current, while the inventors of the electric silo express the contrary opinion in their articles explanatory of the system.

The influence of the current on the micro-organisms in the electrosilage is undoubtedly a matter of first importance and closely allied with this is the question of the behaviour of plant substance as a carrier of bacteria.

Numerous experiments have shown that the number and kind of the bacteria present in the silo largely determine the processes of conservation and are in reality the cause of injurious metabolism in the plant substance. On the other hand the favourable action of lactic acid fermentation set up by the lactic acid bacteria at that stage is highly desirable, provided that the development of the amount of lactic acid necessary to conservation is not accompanied by detrimental changes in the plant substances.

The electric turret silo on the Steinbeise estate in Brannenburg,

(1) Work has also been done recently by G. WIEGNER, C. CRASEMANN and M. KLEIBER in Zurich, and is reported in the *Landw. Jahrbuch der Schweiz* 1923, Part 4.

Upper Bavaria, was used for bacteriological experiments in connection with silage. It was erected by the Electric Silage Co. of Dresden and worked in accordance with their instructions. The electric poles in accordance with the Schweitzer plates system consist of an iron grating on the floor of the silo and a sheet tin cover in six divisions which is laid on the forage mass after the silo has been filled. By means of a transformer the tension of the current available for the process was raised to 380-220 Volts. As only one receiver was to be used only one phase of the alternating current could be applied. The walls of the receiver (silo) consist of grooved concrete made on a special pattern. This concrete is faced on the inner side with insulating material, which forces the current to pass through the forage mass. Meadow hay was always used for the experiments, wet with dew, chopped to one and a half centimetres and placed in the receiver in layers. The grass was the yield partly of a water meadow with poor herbage including many kinds of rushes, partly from an average meadow with good herbage. Both were typical mountain pastures of the Bavarian Alpine foot-hills. In order to ascertain what micro-organisms were present, bacteriological tests were made on October 25, 1922 by the HILTNER method of pure cultures in a pulse nutrient medium which on calculation showed the following results:

Total number of bacteria in one gramme of grass.

Fresh grass from	Cultures			Average
	A	B	C	
Poor meadow.	450 400 000	428 000 000	480 800 000	453 200 000
Good meadow	238 400 000	294 400 000	434 800 000	322 800 000
			Average	388 000 000

The number of bacteria present in the grass is according to these experiments normal and the same is true as regards the type of micro-organisms found. No steps were taken for isolation of pure cultures after it was ascertained that the micro-organisms present belonged mainly to the lactic acid forming type (long and short lactic acid bacteria and micrococci of the lactic acid forming type), with a large intermixture of *Bacillus subtilis* and a few fluorescents. The practical purpose of the work made it unnecessary to distinguish the numerous varieties with their uncertain classificature. The chemical

analysis was carried out at the "Hauptversuchsanstalt für Landwirtschaft" (Agricultural Head Experimental Station) in Munich with the following results:

	Poor meadows	Good meadows	Average
Water	83.24 %	84.24 %	83.74 %
Dry substance	16.76	15.76	16.26
Protein	2.71	3.10	2.91
Crude fibre	5.02	3.10	4.06
Acidity	0.28	0.34	0.31
Volatile acids (butyric and acetic acids)	—	—	—

At the time the silo is filled a shaft is built into it, made of overlapping boards, with holes in the side, so as to make it possible to remove samples of the forage from different places in the silo. The electrification of the green forage mass of 493.2 centners (20 double yoke loads with 27.4 cubic metres capacity) was effected by a normal application of current (1).

The silage when finished was olive green to brownish in colour, had the aroma of freshly baked bread and was readily eaten by stock. Samples of the good and the poor grass were taken after electrification on 15 November and were subjected to chemical analysis:

Micro-organisms per gramme of electro-silage.

Electrosilage taken at	Cultures			Average
	A	B	C	
25° C. 55 cm above floor of silo (poor grass)	400,000	nil	nil	133,000
13° C. 1.78 cm above floor of silo (good grass)	nil	400,000	nil	133,000
Average				(2) 133,000

(2) *Penicillium* only.

(1) The cost of current may be ascertained in accordance with the price of electricity by applying the formula that 50 kg. of green forage require one kilowatt per hour. The cost of constructing a silo is determined by the number of cubic metres of the space enclosed. The larger silos cost from 10.5 gold marks per cub. m. and the smaller 17.5 gold marks.

The analysis of acids showed a content of 0.77 % of lactic acid at a temperature of 26° C., and of 1.31 % at 43° C.

The bacteriological result was unexpected in more than one respect. The sample was practically sterile not only at 43° C. but also at 26° C. the temperatures at which the samples were taken. It is not to be supposed that the process of ensilage is only achieved at these temperatures. Very often a temperature of 45-50° C. is reached and is a main factor in the production of lactic acid fermentation.

Temperatures of 45 to 50° C. can be obtained by other silage methods, but these temperatures are not sufficient to destroy the injurious, sporogenous and highly resistant hay bacilli. In the electrosilage however the hay bacillus, which can resist all the effects of natural selection and crowding out by other organisms disappears entirely. There was also a very striking absence of all micro-organisms when the hay was taken out of the silo at a temperature of 26° C., whereas it might have been expected that the injurious hay bacillus which thrives in low temperatures would once again be found. It is well known that the production of lactic acid by the lactic acid bacteria involves an after fermentation. On the other hand it was to be expected that the electric current would at least have a selective destructive action on certain groups of bacteria. This was confirmed by the fact that even in the streaks there was no sign of renewed activity. In every case it is to be noted that in the Brannenburg experiments a temperature of 45 to 50° C. has been reached in the silage process.

The interesting question now arose whether the electric silage would remain sterile. The silo was left untouched all the winter, until on 26 January 1923 it was necessary to open it because of the requirements of the farm and samples were then taken and analysed as the final stage in the experiment. There was no change in the appearance of the forage; it was as at first olive green to brownish, had a pleasant odour resembling bread and was readily accepted by the stock. The milk yield maintained the average customary for the dairy cattle in Brannenburg fed on the mountain grass as described. The silage was packed into the container so that the samples could only be taken by means of a specially constructed spoon shaped implement. Examination for micro-organisms gave the following total number of bacteria to one gramme of electrosilage:

Electro-Silage taken out at	Cultures			Average
	A	B	C	
4° C. (at a dept of 30 cm. in the silo)	nil	nil	nil	nil
5° to 6 C. (at a depth of 1.2 m. in the silo) . . .	400 000	—	800 000	400 000
			Average. . .	200 000 (1)

(1) *Penicillium* only.

According to the chemical analysis the feed has the following composition :

Water	77.0 %
Dry matter	23.0 %
Protein	3.31 %
Crude fibre	4.96 %
Total free acids	0.49 %
Volatile free acids	0.20 %
(Acetic acid admissible	0.5 %)

Taking the experiment as a whole the following description may be given of what took place during the forage conservation.

The chopped wet grass had been practically rendered sterile and so remained for the whole time it was kept in the turret silo (90 days) By the action of the electric current not only were the lactic acid bacteria destroyed, but also bacteria resistant to high temperatures of 70 to 100° C.

The removal of valuable constituents, such as albumen, which usually results from the losses in substance, did not occur to any marked extent through the process of electric ensilage. This fact suggests that the injurious processes of decomposition are largely checked by the electric current and in any case are unimportant. Hence the products of decomposition, such as free organic acids, appeared in very small quantities only, remaining considerably below, the limit of error. No butyric acid could be detected, and only traces of acetic acid, while lactic acid only occurred to the extent normally found in autumn forage. Hardly any of this acid has been lost, and there is more than enough to prevent any renewal of activity in the bacteria and therefore to preserve the silage.

PLATE XXVIII.



FIG. 93. — View of the Central block of model installation with six electro-silos belonging to the Electro Silage Co., Dresden C. (August Monal, Bad Tölz).

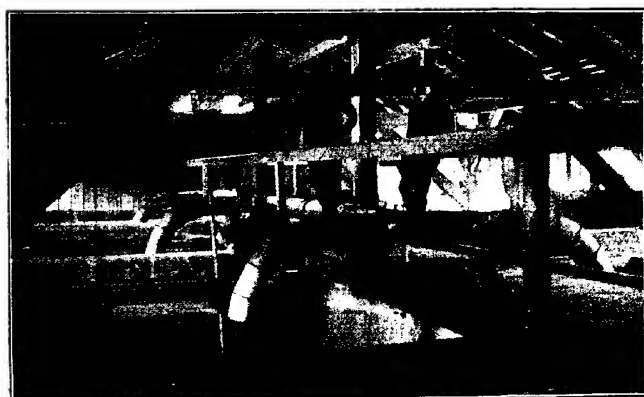


FIG. 94. — View of six silos with suction tube plant for blowing in the chopped forage.

As regards the chemical changes which take place in the silage, the loss of water is chiefly due to the evaporation caused by the heating of the grass mass. Accordingly the dry matter content of the silage is very high compared with that of the mass of green grass, and the same is true of the crude protein and crude fibre content. The albumen content in the dry substance was actually only reduced by 1 to 2 % except for a few tenths per cent., which come within the limit of error. Since the lactic acid bacteria hardly attack albumen at all (1), the material for forming the lactic acid is chiefly to be sought in the N-free portions. According to SCHULZE's experiments the electrolytic process which takes place in the electro-silage brings about the splitting up of the otherwise refractory crude fibre into N-free extracts, a fact of great importance from the nutritive physiological standpoint, and thereby increases the availability of the silage. It is worthy of mention, as evidence that practically no substantial change had taken place in the forage as a result of the ensilaging process, that a cow in Brannenburg which was accustomed to good grass recognised even in the form of silage that poor grass had been placed at the bottom of the silo, and refused to eat it.

Losses arise not only as a result of bacterial activity, but also of the respiration in the layers of forage plants which are still alive, the loss being chiefly from the carbohydrates. Previous experiment has shown that the action of the electric current sets up rigidity of the cell plasm (2) which probably at once inhibits respiration. If the cell is not already dead, it is certainly destroyed when the temperature rises to 35° C., a temperature reached in the electrosilo soon after the current is applied. As has, however, been said the losses are quite negligible.

The electro-silo thus fulfils two of the main requisites of a method for the preparation of conserved forage: 1). The source of energy is well suited to the purposes so that all waste of nutritive substances is avoided; 2) The nutrient value of the forage is retained as the method allows conservation at the right stage even under unfavourable weather conditions, as has been fully shown by the numerous experiments described.

(1) This experiment proves beyond doubt that the conservation of forage by electricity is a method of special excellence, since it makes possible the sterilization even of wet grass, and its preservation in practically perfect condition.

Naturally the lactic acid bacteria need a small amount of nitrogen for their own life processes.

(2) BERSA and WEBER, Reversible Viskositäts-erhöhung des Cytoplasmas unter der Einwirkung des elektr. Strömes. Reports of the German Botanical Society, Part 7, 1922.

The importance for agricultural production of these merits in the electrosilo is clear from the following facts :

For some years past the agricultural division of the *Landesanstalt* has been carrying out in different parts of Bavaria under the direction of Regierungsrat (Councillor) LANG experiments in the application of nitrogenous fertilisers to meadows, one of the places chosen being the Steinbeis estate at Brannenburg in Upper Bavaria. The object of these experiments was to determine the effect of nitrogen upon the yield and quality of the meadow grass, and the agricultural profits to be obtained from the use of nitrogenous fertilisers. Though not yet complete, they have been carried far enough to prove that nitrogenous fertilisers under certain conditions pay extremely well. At Brannenburg in the dry season of 1921 there was a yield of only 450 double centners per hectare of green forage, corresponding to 90 double centners of hay, as the result of four mowings. One kg. of pure nitrogen applied as manure produced up to 50 % increased yield of nitrogen in the form of protein, so that the balance as regards nitrogen is entirely satisfactory. Hay harvesting owing to the uncertain and rainy weather that prevails at Brannenburg is always difficult : the Herbasilo is of no use, as it requires a succession of good haymaking days. The electrosilo is the only type suitable for stacking and preserving the crop without loss.

A report has been issued by the Steinbeis estate of the Bavarian *Landesanstalt* on the experience gained by the use of the experimental electrosilo at Brannenburg, of which the essential points are as follows :

"The electro silo was erected in the summer of 1922 at a cost of 200 000 paper marks, the necessary technical assistance being provided by the Electric Silage Co. It is a turret silo with a total forage capacity of 70 cub.m. One cubic metre corresponds to 18 to 20 centners of green stuff : this amounts to about 25 to 30 days rations, if silage is fed exclusively. After mowing the forage is put into the silo chopped to lengths of one and a half cm. The hay is allowed to lie on the meadow for one to two days, and rather longer in wet weather. The passage of the current is facilitated if the grass is not too dry and withered. If the forage is put into the silo fresh, no nutrient material is lost. The silo does best when filled to the height of one metre, and this mass will be silaged in 6 to 10 hours. It is then chopped again and every evening the six-piece cover (the electrode) is replaced, and the current again passed through, till the con-

servation is complete. It is an advantage if two tensions are available. The stronger current is first applied, then the weaker, till an equable temperature of about 50° C. can be established. The alternating current is the most suitable whereas in other silage methods heat is produced by the respiration of the plant cells and the bacteria, in the electro-silo the current is the heat generator and it therefore becomes possible to introduce the forage at any stage.

It is desirable that there should be some air in the silo, as it assists the passage of the current. The forage must be placed in layers as thickly and evenly as possible. By the passage of the current it will soon be seen if the forage has been sufficiently compressed. Forage which has lain for two hours under the influence of the current and is then thrown out and remains lying in heaps, is no longer capable of spontaneous heating.

When the process was complete the silage had still kept its original appearance and smell as on the first days after the ensilaging. This applies even to the lowest layers, this part of the silage *remaining unaltered even after six months*. There was no visible oozing of juices and no moist sediment on the floor of the silo.

After the inferior grass was removed the silage was readily eaten by the stock. The agricultural profits to be obtained from an electric silage plant, are assured except just at the time of installation. Although no exact accounting data are available, there is every reason to believe that, given the benefits that have already been obtained from the use of the silo under the conditions here prevailing, the initial outlay will be very soon written off. Among the principal advantages may be mentioned the following: —

- 1) The grass can be cut and carried to the silo at any time and can be kept there in its original condition and without loss.

- 2) Harvesting of the forage crop can begin earlier, and hence the growth period can be used to better advantage. The heavier rainfall of June thus benefits the second crop, instead of coming in the middle of the haymaking.

The meadows can be much more heavily manured. The use of nitrogenous fertilisers after the first and second cutting will pay well and a twofold increase in the hay yield may be reckoned.

- 4) The earlier and more frequent cutting (as many as four cuts being possible) and the more intensive manuring enrich the meadows. The weeds that are annuals disappear.

- 5) More head of cattle can be kept on the same or a smaller

area, as both in summer and winter there is always fresh rich forage for the animals. The milk yield is subject to less fluctuation. There is no need for additional purchases of concentrated feeds.

The electric current method of forage conservation thus appears from every point of view to be highly important to the national economy. Up to the present however an approximate estimate only of the results is possible.

III.

Judging by the foregoing experiments (1) it is impossible to doubt that the electric current has the power of killing bacteria and life in the higher plants, and also of conserving the green forage to a remarkable degree. But in spite of this the specific action of the electric current remains as yet unknown. This problem seems to call for elucidation, although the practical outcome of the process, viz: the electric silage itself, hardly admits of further improvement. But only the specific action of the current can give the clue to the form the application of the electricity should take scientifically, so as to keep the expenditure of current and the costs of production as low as possible. This is the difficulty not merely of "electrosilage" but of the whole question of ensilage, bearing in mind that the electro-silo meets all the other requirements of a satisfactory method of forage conservation. In so far as the bactericidal action of the current was considered at all, it was ascribed mainly to the fact that since forage is a bad conductor of heat, warmth is generated, which kills the bacteria at about 50° C. In order to make the action of electricity more intelligible, the forage mass has been compared to the metallic wires in the interior of an electric bulb, or to an, "incandescent" carbon burner in which heat is generated through electricity as a consequence of resistance to the current. Without denying that many species of bacteria are destroyed by heat, the bacteriological experiments of Prof. KINZEL and of the present writer give reason to suppose that there are other specific effects of electricity. It is *a priori* clear that a living organism reacts to electricity quite differently from a piece

(1) The results of experiments are confirmed by the electro-silage experiments carried on simultaneously by Prof. SCHEUNERT and Dr. SCHIEBLICH Berlin. While meadow grass was used in the Munich experiments, turnip leaves, serradella and carrot tops were used in Berlin.

PLATE XXIX.



FIG. 95. — Interior of a silo.
Taking of temperature after removing lid of an electrode.

of metal or a carbon thread. The reasons for the action of the current will differ according to the kind of forage in the silo, the structure of the plants, the pressure, the shutting off of the current, the relative position of the electrodes, the amount of humidity present in plant juices, the sourness, and also according to the type of current, whether alternating or uniform. The following possibilities must also be taken into account: production of electric heat in consequence of the resistance to electricity of forage plants which are bad conductors, protected as they are by the waxy layers of the epidermis, electrolysis of the fluid components due to the formation of bactericidal poison (formation of Chlorozone), mechanical effects caused by the loosening and destruction of the tissues, physiological effects due to temporary or permanent hardening of the cell plasm, the various micro-organisms showing themselves either sensitive or protected by layers of cuticle or mucous membrane, specific action of high-tension alternating current, discharge of sparks, production of ultra-violet rays, diathermia (?), automatic induction and so on.

In accordance with the fundamental assumptions of modern electrophysiology, electricity passing through a living organism (see fig.) reveals its presence *not merely by the generation of heat*, but also by the fact that it sets up vital phenomena, or inhibits them or changes their form or direction. This important fact has been used and adopted in electrotherapy, while in the sphere of agriculture it has not yet been turned to account for want of a corresponding technique. One of the manifestations of the types of electrical activity just mentioned is known as a "stimulus" in the widest sense, in so far as it produces excitement, inhibition, or paralysis which may lead to permanent functional and anatomical injury. Accordingly the question under consideration is that of electrical stimuli during the action of the current on the stalks of the forage plants. These fall under Ohm's law and in this connection inhibiting action is particularly noticeable.

Ohm's law deals with the relations between electromotive force (tension), resistance to conductivity and strength of current (intensity). The interplay of these factors determines the specific effective potency of the current and this finds expression chiefly in thermic, chemical and mechanical action. The strength of the current is the chief factor determining the cost of its use. Since the forage mass in the electric silo constitutes a conductor of the second class thus involving a high resistance to conductivity, it is essential, if phy-

siological inhibitions are to be obtained, to secure a high electromotive power (tension). In the case of bacteria this tension will be still more important, as it is necessary to penetrate the natural protective media, such as cutine and waxy layers, mucous linings, etc.

In view of these considerations an experimental proof of these theories will be of special interest and the question arises exactly how the electric current at high tension, without any rise in temperature, can affect the bacteria and this at the most important stage in the process of ensilage. In the following experiments of Prof. KINSEL and the writer, the strength of the current was kept very low in order to avoid a rise in temperature.

Ten grammes of fresh grass were put into a flask containing a litre of water and for a period of 12 hours a current was passed through twice every hour, the mixture was electrified, lead electrodes being used and an alternating current at a tension of about 20000 volts and one tenth mille amperes applied. In this combination of factors the experiment corresponds to the first phase of conservation in the electro-silo, when the resistance of the forage mass is very considerable. The experiment is of course only intended to solve general problems as to the effect of the current, and no exact correspondence to the conditions of the electro-silo can be expected. To test the influence of the high tension current on the bacterial content of the grass, the micro-organisms per gramme of the content the flask were counted. There were found to be :

Average of two tests	
Not treated with electricity	Treated with electricity
31 000 000	80 000 000 micro-organisms

The multiplication of the bacteria to far more than twice the original number indicates that even apart from electro-heat the current has an influence on the bacteria which can only be regarded as a stimulus. No change in the temperature had occurred, the electricity had during the short time of its application in no way injured the vital functions of the bacteria but on the other hand had been favourable to them. As a set off to this experiment another might be devised corresponding to some extent to the last phase of the electric ensilage process, when the action of the tension current in the silo has broken down the resistance of the forage mass and the electricity passes without hindrance through the forage and since there is no resistance, no more electro-heat is generated.

PLATE XXX.

CULTURES



FIG. 96. -- Untreated (numerous micro-organisms).

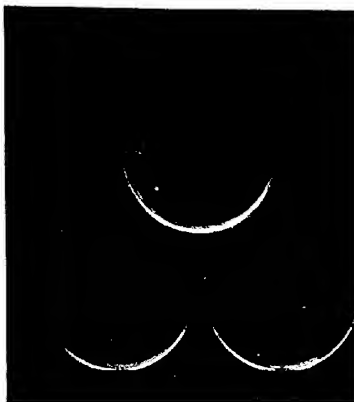


FIG. 97. -- Treated with electric current. S. Experiment 8. s: very few micro-organisms. Effect of high tension alternating current on germinating capacity of the bacteria.



Living shape.



Rigid shape after destruction of life by the electric current.

FIG. 98. -- *Euglena viridis*, micro-organism of the Flagellatae.

A bacteria-containing fluid *free from any infusion of grass* was electrified as in the preceding experiments, and in this case no change took place in the temperature which remained the same before and after treatment by a high tension alternating current of low power (1).

The bacterial content of one gramme of fluid in the cultures was as follows :

	Not treated with electricity			Treated with electricity		
	Anaerobic	Aerobic	Total	Anaerobic	Aerobic	Total
Micro-organisms (in thousands), Dilution 1:1000:						
Culture tests { A	700	350	1 050	nil	40	40
B	725	350	1,030	"	63	63
C	307	610	917	"	36	36
Micro-organisms (in millions), Dilution 1:1,000,000:						
Culture tests { A	620	320	1 000	nil	28	28
B	400	800	1 200	"	40	40
C	—	—	—	"	27	27

The bacteria, particularly the anaerobic forms, have been almost completely destroyed as the result of the electric force (tension) of the current. There was no possibility of the action of electro-heat in this case. (See fig. 97).

It is therefore clear that the specific effects of the electricity are also of significance in the electro-silage. It is also probable that complete sterilization was obtained in the tests made with the Brannenburger silo simply because the tension was sufficiently high and hence the hay bacilli, which are usually so difficult to kill, were destroyed.

In any case the experiments described above show that for electric sterilization the high tension of the current, among the factors of Ohm's law has special importance, and that along these lines it may be found possible to reduce the current consumption and the production cost of electro-silage. The experiments also suggest the importance of investigating these processes as they occur in electro-silage in order to avoid unnecessary current consumption and to

(1) The experiment carried out at the *Landesanstalt* confirmed the results of a great number of experiments made by the present writer some years ago.

reduce the cost of employing this form of silo. More recent experiments with high frequency apparatus prove that by the application of high tension alternating currents with more than a million alternations per second the coniform coagulation of the albumen follows as the result of the diminution of intensity of the electric force at the pole of the electrode. It is thus also probable that the current density in the forage is of special importance for the complete electro-sterilization.

Scientists have already studied the question of the best use to make of the specific effects of electricity in electro-silage and in particular so as to secure conservation in the shortest possible time. VIETZE of Halle was the first to formulate a method based especially on electro-heat. Spiral electrodes known as "electro-forage boilers" are inserted into the forage mass and directly connected with a high tension wire. In this way the three phases of the alternating current may be applied to a single silo container to economize power.

This method has so far been insufficiently tested to justify a definite opinion as to its value. The new method which is now being perfected by the Electro Silage Co., and is said to embody the results of the latest work on the electric ensilage problem, appears to be still more promising. In this system, rod shaped electrodes are inserted laterally into the mass of forage. This new method may in point of fact indicate far reaching improvements, and merits special attention, as it represents on the one hand a particularly suitable means of conservation for average sized and small farms, and on the other provides that the required temperature will be reached in a considerably shorter time than was practicable by the methods hitherto employed. According to the preliminary experiments made by the Company, favourable results may be expected. In the coming spring detailed tests will be made with the new method by the *Landesanstalt* with the help of the Steinbeis estate.

It is to be hoped that the combined efforts of science and technology may be successful in bringing the electro-silo to such a stage of perfection that it may be able to supply the needs of even quite modest farms as regards a reliable method of forage conservation. It will only be possible to speak of a real solution of the electro-silo problem when in every case a high quality feed can be obtained such as was shown to be possible in the experiments made at the Brannenburg silo. If, owing to technical defects or mistakes in preparation an electro-silo produces a forage which shows marked signs of sour-

ness as the results of the presence of butyric acid, it would be quite misleading to quote this as instance of electro-silage.

Science and technology must also combine to reduce the production cost to the point where it no longer stands in the way of a general adoption of electro-silage methods. The object of the present article is to suggest the means to this end.

It also suggests the high economic importance that can be claimed for silage methods and more particularly for the electro-silo as regards the development of agricultural production. Its possibilities for making good the shortage of cattle feeds are illustrated by a number of examples drawn from agricultural practice showing that by the use of electrically prepared forage the milk yield can be raised by about 50 %. Although modern methods of forage preservation may provide a valuable and nutritious feed it can never of course be a complete substitute for the rich concentrated feeds, and the existing shortage in this respect can only be satisfactorily relieved when these concentrates once again reach Germany in sufficient quantity.

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AGRICULTURAL INTELLIGENCE

AGRONOMY.

SYNTHETIC ARTICLES.

531 The Estimate of Probabilities Applied to Field Experiments.

I. — Bibliography of Standardisation of Field Experiments. *Journal of the American Society of Agronomy*, Vol. 15, No. 1, pp. 33-40. Lyon Block, Albany N. Y., 1923.

II. — ROEMER TH. Der Feldversuch. Eine kritische Studie auf naturwissenschaftlich-mathematischer Grundlage. *Arbeiten der Deutschen Landwirtschafts-Gesellschaft*, Part 302, pp. 1-69, graphs 2, bibliography. Berlin, 1920.

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VI. — SUMMERBY, R. Replication in Relation to Accuracy in Comparative Crop-Tests. *Journal of the American Society of Agronomy*, Vol. 15, No. 5, pp. 192-199. Geneva, N. Y., 1923.

VII. — CZUBER, E. Zur Frage der Anwendbarkeit der Wahrscheinlichkeitsrechnung auf landwirtschaftliche Versuche. *Zeitschrift für Pflanzenzüchtung*, Vol. VIII, No. 4, pp. 331-339. Berlin, December 1922.

On the occasion of the Meeting of the American Society of Agronomy, in November 1922, the Committee on Standardisation of Field Experiments presented a list of 155 works dealing with the standardisation of field experiments. Among these works (most of which were published between 1910 and 1922), there are a considerable number that deal with the interpretation of results, including the estimation of probable errors, and hence with the estimate of probabilities as applied to agriculture.

The International Institute of Agriculture has not reviewed any works published on this subject since 1918, therefore we here give a summary of ROEMER's article (published in 1920), which is a very clear exposition

of the question. We will afterwards speak of the practical application of the method of calculation as established by VON RÜMKE.

II. — The technique of field experiments made great progress during the years shortly before and after 1880, and then became stationary; it is only recently since VON RÜMKE published his methods of research that much attention has again been given to the question.

The method of carrying out field experiments differs according to the objects in view, which vary greatly and may include the testing of fertilisers, the trial of species and of their value for breeding purposes. The more specialised the experiment, the more valuable are likely to be the results.

In order to ensure success, the following conditions are always indispensable; personal interest, the services of a competent Staff, sufficient means at the disposal of the investigator and a homogeneous experiment field.

The accuracy of field experiments. — The value of each experiment depends upon the exactitude of the harvest results, which is best insured by the determination of the average error which should be expressed as a percentage of the suitable value. It has been calculated according

to the law of GAUSZ that $m = \frac{\sigma}{\sqrt{n}}$ where m is the average error of the mean,

σ the average error of each experiment or the deviation from the mean, and n the number of experiments. These values m and σ are also employed in treatises on variation and heredity, and the author is of opinion that it would be better to adopt them in agricultural chemistry rather than r , the probable error which is equal to $0.645 \times \sigma$ and $R = 0.645 \times m$, values, depending upon the "chance curve" of GAUSZ.

Application of the estimate of probabilities. — After much discussion on the part of authors such as BAULE, RODEWALD (mathematicians) and ALEXANDROWITCH, EHRENBERG, GORSKI, HALL, MERCER, PFEIFFER and RUSSELL, it has been agreed only to take into account in field experiments those results that arrange themselves symmetrically according to the curve of GAUSZ. A distinction is to be drawn between systematic errors and chance errors. Under the former head come in the first place all differences in the soils of the experiment fields owing to which, field-experiments can never be as accurate as laboratory experiments. Accidental errors are of many kinds and may consist of variations due to persons, or instruments, disturbances caused by higher animals, insects, diseases, and weather (hail, wind rain), theft of sheaves, etc.

Accidental errors may be larger, or smaller, than systematic errors and may mask them, or be masked by them. Errors due to accident are characterised by their at one time increasing and at another time decreasing the results. GAUSZ's curve can be applied to them. Systematic errors may deviate from the above curve, but even in these cases, it is still possible, according to BAULE, to calculate the average error, but not the value of the probable error which can only be done by means of the symmetrical curve.

The accuracy of field-experiments as at present conducted, is very

low, the value of m being about 10 %. This is not at all sufficient, for any useful work, m must not exceed 3 % at highest.

Investigations into the sources of error in field experiments. — In order to correct the technique of field experiments, it is necessary first to determine the amount of the errors due to different circumstances for it is useless to correct small errors unless the large ones are rectified. By estimating the probability, it is possible to determine the effect exercised upon the accuracy of the experiment by such factors as the size of the crop, the homogeneity of the soil, the size, shape and situation of the plots and the number of repetitions. For this purpose the author has made use of a large amount of material, the crop results obtained from a series of experiments carried out by 9 different authors of which the figures are summarised in 13 tables.

Shape of the plots. — The more homogeneous the soil, the less is the accuracy of the experiment affected by the shape of the plots. Much attention must be paid to a suitable selection of the form of plot when the total area is extensive. Elongated shapes give more exact results than any form approaching a square.

Arrangement of the plots. — It makes little difference how the plots are arranged. MITSCHERLICH advises their being in a line, while ENEKE prefers that they should be placed in a square.

Size of plots. — This has a great effect upon the accuracy of the results. The larger the space occupied by each individual plant, the greater should be the size of the plot.

According to the calculation of the average error, it may be said that the accuracy of the results increases with the size of the plots, but the decrease in the average error thus obtained is greatest when the soil is least homogeneous.

The ratio between the amount of the average error and the size of the plot can be expressed by the following formula $\frac{V}{\sqrt{g}}$ where v is the average

error expressed as percentage and g is the multiple of the original size. By the help of this formula, it is possible in any case to find how much the plots must be enlarged in order to reduce the average error to a determined figure.

Number of repetitions. — Theoretically it is to be expected that the average error of the mean should decrease with the increase in the number

of repetitions according to the formula $\frac{\sigma}{\sqrt{n}}$ where n is the number of plots,

and this formula can be applied practically. The number of repetitions, or parallels, is the factor exercising most influence upon the accuracy of field experiments and the most effective way to correct the technique employed is to increase the number of parallel plots.

Total surface of the experiment field. — If the number of parallel plots is increased without increasing the total area, the area of each plot is necessarily diminished which does not tend to promote accuracy. A si-

milar lack of accuracy often results from extending the total area as well as increasing the size of the plots, for in this case the soil may be less homogeneous. Parallel plots should not be situated too far apart for the agreement of the result of such plots is a function of this distance. The practical conclusion to be drawn from this is that in a series, the number of the subjects of experiment should be limited. To this end, comparative experiments of species, for instance, ought to be subdivided into groups, or series, one of the species of the first group being introduced as a control into the second and third groups.

This method of subdivision into series, if accompanied by an increase in the number of repetitions, is the best method of correcting the technique in field experiments (see also the Standard method of HOLSTMARK and LARSEN which is much used in America).

Effect of the season. — It can be seen from the tables that the accuracy of the data obtained in field experiments varies more or less, according to the season. This depends upon the rain that has fallen during the year. More accurate results are obtained when the weather has been favourable and the crop is therefore heavy.

A good deal also depends on the kind of crop grown. Cereals are more easily and exactly harvested than leguminosae. Beetroots are more troublesome than the leguminosae, while the hay harvest is attended by many risks.

Sowing and harvesting. — Errors due to variations in the amount of seed used can be prevented by employing seed-drills which are especially suited to experimental work. The average error due to differences in germinating capacity and other accidental causes would be about 2 %.

The method of harvesting and of ascertaining the yield are both very important. In the case of species experiments, or quality experiments with a view to plant-breeding, the whole harvest is gathered. In manual experiments, WAGNER'S method may be adopted. This consists of taking a sample of 5-10 kg. of freshly cut wheat, drying it under shelter, and then weighing and threshing it, the yield being calculated. In this case, the factors of bad weather, and loss by bird attack or theft are not considered. The defect in this system is that only one, instead of 6, similar samples are taken.

Choice of experiment field by means of "blank experiments". — The similar plots are sown and manured alike and harvested separately; any differences that occur are then chiefly due to differences in the soil. This is often a good method for selecting ground suitable for experiment fields.

HOLSTMARK and LARSEN'S standard method. — A certain number of plots, termed control plots, are sown with the same species and manured alike; each experimental plot has a control plot adjoining it. The crop of the two plots are compared and any differences are to be attributed to the soil. It is, however, better to use 3 control plots, instead of 1, for each comparison. In this manner, the "ideal" value of the control is obtained and the average error reduced from ± 2.92 to ± 2.03 . This method is much used in Scandinavia and America.

The best results are obtained by combining the Standard method and the method of many repetitions.

To sum up: the author states that species experiments and quality experiments to determine the best plants for breeding, should be conducted differently. The plots ought to be smaller and the parallel plots more in number. VON RÜMKEK insists on 4 repetitions, the author is not satisfied with fewer than 6. The size of the plots should be:

- for cereals, about 15 m².
- for leguminosae 25 m².
- for beets etc. 25-50 m².

In manurial experiments the plots must be 100 m² and there should be parallel plots separated by sown protecting borders.

Soil treatment experiments require at least 4 parallel plots of about 500 m². Still larger plots are necessary for experiments in soil improvement.

III. — The author has used VON RÜMKEK's method in comparing 7 kinds of barley: Brunhilda, Eglfinger, Engelen, Streng, Ackermann, Freidrichswerther, and Eckendorfer. In another series of experiments, 8 types of winter wheat were compared: Diva, Traublinger, Bayernkönig, Siegenländer, Engelen, Holzapfel, Elsässer Rot, Barbingen.

The author recognises the great value of VON RÜMKEK's method for this class of experiment. In Germany, some of the first scientific trials of wheats on a large scale were made by the Deutsche Landwirtschafts Gesellschaft (See: *Arbeiten der D. L. G.*), but unfortunately, as may be seen from the reports of that Society, the experiments are still too often conducted with only 2, or 3, parallel plots. The author emphasises the great importance of a large number of parallel plots being employed, especially in preliminary experiment.

IV. — The author publishes the results obtained from an experiment with different kinds of potatoes. The experiment from which no new data were obtained, was undertaken with the object of showing that any well-conducted experiment chosen at random suffices to prove the truth of VON RÜMKEK's theory. The estimate of probabilities, if thoroughly understood and properly carried out, affords a protection against false conclusions. The method of making calculations of this kind is so simple that it can be taught successfully in the Intermediate Schools of Agriculture.

V. — This author's work is confined to selection trials. He is of opinion that it is sufficient to repeat the experiment 4 times using three rows of plots 5 metres in length. In his calculations, he takes the probable error into account.

VI. — In the opinion of this author, increasing the length of the plots does much more to decrease the errors than increasing the width of the plots. Great importance is attached to the number of parallels and it is considered that in comparative experiments of yield, the error cannot be less than 6 % unless 8-16 parallel plots are employed.

VII. — The author questions whether GAUSZ's theory which is applicable to the minute measurements required by astronomy and geodesy

is equally suitable to agricultural experiments. He doubts how far the labour involved in making the calculations is justified by the results and considers that the object in view, viz., the classification of different types of plant according to their quality could equally well be attained if the calculations were considerably simplified. His remarks are made with special reference to VON RUMKER's "Simple Rules for Non-Mathematicians" (*Fühlings Landwirtschaftliche Zeitung* 1921, pp. 458-461) which he regards as far too complicated for practical use.

When it is a question of a series of experiments undertaken for a single purpose (for instance, the yield of a certain species of wheat grown on different plots), the less the difference between the results, the more nearly will they approach the "normal", that is to say, not only is the yield itself important, but the degree of fixity is also taken into account in estimating the quality of a wheat.

It is very easy to calculate the normal yield; all that is needed is to take the arithmetical average. To determine the fixity is a more complicated process. Some of the deviations from the mean will be positive and others negative. On taking the squares of the deviations, the negative signs disappear and the sum of the squares varies inversely with the degree of fixity. This sum depends upon the number of the experiments. In order to have a general measure of the fixity, it is thus necessary to divide by this number and afterwards extract the square root of the quotient obtained. This gives the "mean deviation of the arithmetical mean" which is a measure of the stability and renders inevitable the "probable error". This method has already been employed in biology.

To still further simplify the calculation of the mean deviation, the sum of all the deviations — irrespective of the signs — may be found and divided by the number of experiments. This value can also be taken as a measure of fixity but it is less obvious.

The author explains his theory by giving an instance from VON RUMKER's work on the classification of 36 species of beets.

Species I.

Yields	Absolute deviations	Squares of deviations
103.4	25.2	635.04
103.9	24.7	610.09
69.7	9.5	90.25
73.8	5.4	29.16
64.5	14.7	216.09
59.1	20.1	404.01
Average . . . 79.2	Sum . . . 99.6	Sum . . . 1988.64

$$\text{Average deviation . . . } \left\{ \begin{array}{l} \sqrt{\frac{1988.64}{6}} = 18.18 \\ \frac{99.6}{6} = 16.60 \end{array} \right.$$

Species 6.

Yields	Absolute deviations	Squares of deviations
85.8	22.7	515.29
80.2	17.1	292.41
58.2	4.9	24.91
52.0	11.1	123.21
53.0	11.1	123.21
50.3	12.8	163.84
Average . . . 63.1	Sum . . . 79.7	Sum . . . 1 242.97

Average deviation . . .	$\sqrt{\frac{1\ 242.97}{6}} = 14.38$ $\frac{79.7}{6} = 13.28$
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Whichever of these average deviations is taken, the result will be the same.

Species 1 is superior to 6 as regards yield, but inferior to it from the standpoint of fixity.

The author subsequently gives the definition of the average deviation from the species average, which is the average deviation spoken of above divided by the square-root of the number of the experiments.

After criticising the work of ALEXANDROWITSCH and of VON RÜMKE who have introduced other factors necessitating much calculation, the author concludes as follows:

a) When a single series of experiments has been made for a given end and it is wished to express in figures the result obtained, it is sufficient to give:

1) The arithmetical mean of the results.

2) The degree of fixity as shown by the mean deviation from the average.

b) When it is a question of a complex of experiments such as is necessary, for instance, in the classification of a series of species, this work can be considerably simplified. After calculating the average yield of each species and all the deviations from this average, the squares of these deviations are obtained. These values are sufficient to enable all the work to be taken in at one glance.

I. The "averages" thus calculated give information regarding the crop-yielding capacity of the species.

II. From the "sums of the squares" is known the fixity and the stability. The larger the sums of the square the less fixed is the species.

The species are classified according to their yields. If two species have the same "sum of the squares", no change is introduced into this method of classifying them, and even where they show great differences of yield they, as a rule, keep their place although their fixity has to be

taken into account. The only doubtful case is when the yield of two species is nearly the same, then their degree of fixity must be considered, and if the difference is very slight, it must be acknowledged that calculation cannot decide under such circumstances, so the cultivator must make up his mind whether he prefers higher yield, or a greater degree of stability.

The author classified 35 species of beetroot according to their yield alone and his classification in 19 out of the 35 species was exactly the same as that made by ALEXANDROWITCH (based on the most elaborate calculations). Where the two classifications did not agree, the differences were not great, as is shown, by the following example :

Species 15 — average 69.9, average deviation 11.79.

Species 31 — average 68.0 average deviation 9.07.

In such a case, calculation cannot be expected to prove which of the two species is the superior.

All that has been said here respecting the classification of wheats applies equally well to seed trials, manurial experiments, pot cultures and field experiments.

D. V. S.

532. Soil Toxicity.

I. — GILE, P. L. (Bureau of Soils U. S. Dep. of Agr.), Methods of diagnosing toxicity. *Journal of the American Society of Agronomy*, Vol. 15, No. 8, pp. 305-312, bibl. Albany N. Y., 1923

II. — LIVINGSTON, B. E., (Lab. of plant-physiology, Johns Hopkins University, Baltimore). Some physiological aspects of soil toxicity. *Ibidem* Vol. 15, No. 8, pp. 313-323. Albany N. Y., 1923.

III. — SCHREINER, O. (Bureau of Plant Industry, U. S. Department of Agric.) Toxic organic soil constituents and the influence of oxidation. *Ibid.* Vol. 15, No. 7, pp. 270-276. Albany N. Y., 1923.

IV. — MCCALL A. G., (Prof. of Geology and Soils, Univ. of Maryland) The influence of acidity itself on plant growth, without regard to other factors. *Ibid.*, Vol. 15, No. 7, pp. 290-297, bibl. Albany, N. Y., 1923.

V. — BLAIR, A. W. and PRINCE, A. R. (New Jersey Agric. Exp. Station). Studies on the toxic properties of soils. *Soil Science*, Vol. 15, No. 2, pp. 109-129, 4 pl. Bibl. Baltimore, 1923.

VI. — BURGESS, P. S. (Rhode Island Agric. Exp. Station). A Method for the determination of "active" aluminum in acid soils. *Soil Science*, Vol. 15, No. 2, pp. 131-136, bibl. Baltimore, 1923.

VII. — HOFFER, G. N. (Office of Cereal Investigations, Bureau of Plant Industry, U. S. Dept. of Agric.) Accumulation of aluminium and iron compounds in corn plants and its probable relation to root-rots. *Journal of Agricultural Research*, Vol. 23, No. 10, pp. 801-824, 21 plates, bibl. Washington, 1923.

VIII. — WHITING, A. (Illinois Agric. Exp. Station). Inorganic substances, especially aluminium, in relation to the activities of soil micro-organisms. *Journal of the American Society of Agronomy*, Vol. 15, No. 7 pp. 277-289, bibl. Albany N. Y. 1923.

I. — There are comparatively few data concerning the correspondence between the growth of agricultural crops and the intensity of acidity in

cultivated soils. Recent ecological studies by ATKINS (Relation of the hydrogen-ion concentration of the soil to plant distribution. *Nature*, 5:80-81, 1921) and by WHERRY (Soil acidity: its nature, measurement and relation to plant distribution (1). *Smithsonian Report for 1920*: 247-268, 1922) indicate however, that there is a somewhat close correspondence between the hydrogen-ion concentration of water extracts of uncultivated soils and the naturally occurring flora. It seems reasonable to expect that in the case of agricultural soils there will be found fairly definite degrees of acidity which are especially suitable for the growth of the different cultivated plants, although this degree of acidity may vary considerably with the type of soil. In fact, thanks to the work of the the Rhode Island Experiment Station, there has been available for many years a classification of this general nature.

During the last few years the idea has been growing that a determination of the soluble or "active" aluminium in the soil might give a more reliable indication of the need of liming than a determination of the acidity. It is coming to be generally believed that soluble aluminium is toxic to plants and that the reduced growth of many plants on acid soils is due to the toxicity of the aluminium ions present. The opinion that there is a specific toxicity in the aluminium-ion aside from the acidity which accompanies it is based chiefly on the works of ABBOT, CONNER and SMALLEY, MIYAKE, RUPRECHT and MORSE, HARTWELL and PEMBER, and MIRASOL.

The author passes in review the experiments made by all these investigators and criticises their conclusions. From the investigations that have been conducted thus far, it does not appear to have been established that aluminium salts are toxic to plants in the sense that mercury or copper salts are toxic. The idea that the growth of some plants on acid soils is reduced by the toxicity of the aluminium ion present does not explain the increased growth of other plants on such soils. It seems that the observed facts are better explained by either one of the following view-points:

It may be that the mixture of colloidal materials making up the cellwalls of different roots, function best in mediums of different hydrogenion concentrations. This is largely a speculative matter at present.

Or, it is possible that the good growth of certain plants on an acid soil and the poor growth of other plants on the same soil is simply conditioned by the relative quantities or concentrations of the different mineral nutrients available at this hydrogen-ion concentration. There are some data in support of this view-point. The poor growth and chlorotic condition of certain plants on calcareous soils is due, apparently, to the inability of the plant to obtain sufficient iron under these conditions. The availability of the iron in nutrient solutions is frequently a limiting factor in the growth of plants, and this availability in many nutrient solutions is a function of the acidity.

(1) See R. 1921, Nos. 366, 367. (Ed.)

II. — *Organic toxicity.* The author made a physiological study of the toxic substances in the soil, using the method known as that of biological tests, employing living plants as indicators of the physiological properties of the soil.

A soil may be unsatisfactory either because it supplies some substances *too slowly* to the root surfaces, or because it supplies some substances *too rapidly*.

The toxic substances which the author considers may be either organic or inorganic, non-electrolytic or electrolytic, but they must always be dissolved in the soil solution. It seems to become increasingly evident, as research goes on, that most toxic electrolytes are injurious primarily because of their ions. Only a few kinds of ions lend themselves, as yet, to quantitative study. HAWKINS was able to study copper-ion concentration. Perhaps several other ions have received some special attention, as hydrogen-ion concentration is distinctly a subject for study at present. Hydrogen-ion concentration, whether expressed logarithmically, or in osmotic or other pressure values, is surely important, but other influential conditions should also receive attention.

What has much interested the author in the discussion of "acid" soils, is the curiously unscientific way in which the word *acid* is employed to mean nothing more or less than *toxic*. It is true that many toxic soils have solutions that are acid in reaction, but it does not seem to be generally true that the toxicity of these solutions is proportional to either hydrogen-ion concentration or total acidity. A true picture of toxicity cannot be sketched solely, nor even mainly, with the acidity pencil.

With regard to the origin of toxic substances, it may be said that in some cases the poisons may develop directly from the decomposition of soil materials; or they may be brought from a distance and added to the soil. Thus sugars, celluloses, fats, resins, proteins, etc. are continually added to the soil by the activities and final death of plants and animals. The organic poisons generally arise only after partial decomposition of these materials. Such decompositions are common in soils, through the metabolic activities of fungi, bacteria, protozoa, etc. Dead roots, leaves, bark fragments, etc. may readily give rise to poisons in that way.

STOKLASA's finding that living roots ordinarily give off almost nothing but carbon dioxide, but that these same roots give off organic acids such as tartaric, oxalic, etc., when the oxygen supplying power of the soil is very low, seems to be consistent with what we know about respiration and it appears to supply a basis for a possible explanation of the origin of some toxic substances in some soils. Most organic poisons arise from more or less thoroughly anaerobic respiration — that is — from fermentation. Poorly aerated soils, are apt to be toxic.

Soils in which water stands for long periods, are often toxic. Subsoils are usually toxic where the superficial soil layers are usually moist and where there is inadequate subterranean drainage. Anything that lowers the oxygen-supplying power of the soil, tends to produce the toxic condition.

The HUTCHINS methods for determining oxygen-supplying power, by direct measurement, will probably become of special value in connec-

tion with the dynamic consideration of soil toxicity, as well as in many other physiological and ecological connections.

III. — The investigation of infertile soils from various parts of the United States has received considerable attention. Some studies showed that the harmful influence of the extract from infertile soils can be removed therefrom by certain treatments such as boiling, distilling, or removal by means of absorbing agents like carbon black, ferric hydrate, or other finely divided bodies having an absorptive power. It can also be removed by evaporating to dryness and igniting the residue, or by processes which promote oxydation.

The general properties shown by these soil extracts not only pointed to the presence of a body harmful to plant development, but indicated also that the compound is organic rather than mineral. Several organic compounds have been isolated from such soils, which have quite different chemical properties, thus showing that there is a difference in the nature of the chemical compounds in different soils.

The organic compounds which have been found to occur in soil organic matter affect plants differently; some are beneficial to plant life, others are inimical to proper plant development, and still others have no effect on plant growth. In every soil there exists a balance of these two contending influences, the good and the bad. Whether one or the other predominates is due to soil conditions, drainage, composition, plant occupation, etc., which can be influenced by soil management such as tillage, cultivation, drainage, liming, fertilization and by crop rotation, all of which influence the biochemical factors in soil.

Among the substances harmful to plants the following should receive special mention, as having been found in unproductive soils: Picoline carboxylic acid (moderately toxic, nitrogen in this compound is not available to plants).

Dihydroxystearic acid (destroys almost entirely the normal oxidizing power of plant roots).

Salicylic aldehyde (even more toxic, it is a strong antiseptic, inhibiting the action of bacteria).

Vanillin (an aldehyde and thus a reducing agent. It disappears in well aerated soils).

The author calls special attention to the occurrence of aldehydes in soils and to the facts that aldehydes are almost universally toxic to living cells, and further that aldehydes yield acids on oxidation. Aldehydes may, therefore, be present in any soil that shows acidity. (It is fairly simple in any given case to test the soil for the presence of aldehydes). With active oxidation in the soil all aldehydes will vanish and in many cases even the organic acid resulting therefrom may be destroyed. Liming neutralizes, but also promotes the oxidation.

A remarkable fact in connection with one soil was that it contained a large amount of mannite, as much as 500 pounds per acre. The remarkable part lies in the fact that it should persist in the soil, when it is such an excellent medium for the development of bacteria. The simultaneous presence of salicylic aldehyde (poisonous to higher plants) suggest-

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ed that the mannite in the soil was protected by the antiseptic action of the aldehyde. This case is particularly interesting as showing that soil compounds affect the lower life of the soil as well as the higher plant life, and through these the entire biochemical processes.

The occurrence of certain compounds in soils thus becomes a direct agent in the diagnosis of soil troubles.

The chief aim in improving infertile soils should be to build them up so that they will become good oxidizers and through this become strong and virile soils.

It has been possible to observe the disappearance of toxic soil conditions by thorough aeration and exposure to air by the action of lime and oxidizing fertilizers like sodium nitrate, or the influence of oxidizing substances like manganese.

IV. — *Inorganic toxicity.* It is pointed out by the author that the intensity of acidity, as determined by hydrogen-ion concentration determinations, bears, in general no direct or simple relation to the quantity of acid present in the soil. It has been shown that the intensity of the acidity in many instances is of greater significance in biochemical processes than is the quantity of acid present.

The author gives some data for the tolerance of acidity by bacteria in soils.

V. — *Toxicity due to aluminium.* During the past 25 years much has been written about acid soils and many causes of this unfavorable condition have been suggested, but with all that has been said and done there is not yet unanimity of opinion as to the cause of acidity, nor as to the identity of the substances which produce the toxic effects. Mineral and organic acids, acid salts, soluble aluminum compounds, the removal of basic materials by crops and by drainage waters have been suggested as causes of unproductive acid soils. Recently, considerable attention has been given to soluble aluminium salts as a possible cause of much of the trouble heretofore attributed to "acidity".

The author describes some work done in this direction at the New Jersey station.

Soils which had become toxic through more or less abnormal treatment were leached with distilled water and the leachings analyzed for soluble iron and aluminium and other constituents, and were also used as culture media for the growing of plants. In growing the plants, portions of the extract were used unmodified, and other portions were modified by the addition of soluble phosphates, lime water and by adding ammonia, boiling and filtering to remove soluble iron and aluminium. Normal soils were also extracted and the extract used in comparison with the extract from the toxic soil. The analyses of the extracts from the good and poor soil brought out differences in soil reaction, water holding capacity, total nitrogen and carbon, and water-soluble iron and aluminium.

The culture-solution work makes it very clear that there is something in the extract from the toxic soil which interferes with root development of the plants. The extract from the normal soil gave normal root development, as did the standard culture-solution.

Addition of nitrate of soda and small amounts of soluble phosphates to the extract from the toxic soil, did not correct the unfavorable condition to an appreciable extent.

When the toxic extract was boiled with ammonium hydroxide, filtered and a trace of iron and phosphoric acid added to the filtered solution, normal root and top growth were obtained.

That this improvement was not due entirely to the neutralizing of the acidity is shown by the fact that the standard control solution, which gave normal root growth, had a pH value approximately the same as the pH value of the toxic extract. Aluminium sulphate when added to normal culture solutions in amounts equivalent to, and greater than the Al_2O_3 present in the unmodified toxic extract, gave results similar to those with the unmodified extract. The pH values of the solutions were lowered by the addition of aluminium sulphate, but culture solutions to identically the same pH with sulphuric acid, produced plants much healthier in appearance than the cultures receiving the aluminium sulphate treatment. The results of the work point strongly to soluble aluminium as being responsible in part at least, for the unhealthy root development.

Vegetation tests carried out in small glazed earthenware pots gave results which confirm, in a large measure the culture-solution results. In the pot tests, however, heavy applications of acid phosphate to the toxic soil resulted in a great improvement in growth, even when the pH value was as low as 5. Small applications of ground limestone and basic slag, gave good results in the pot experiments.

When aluminium compounds were introduced without a basic material such as lime, the yields were reduced to less than the yields with the untreated soil (check), but in the presence of liberal applications of basic materials, the aluminium sulphate and aluminium nitrate did not appreciably lower the yields of dry matter as compared with the yields from the basic materials without aluminium compounds.

The result of the pot work also leads one to suspect that soluble aluminium compounds constitute one of the causes of toxicity in soils.

The results of the work indicate that such toxicity may be largely overcome by heavy applications of soluble phosphates or by application of basic materials such as the different forms of lime and basic slag.

VI. — For many years the Rhode Island station has been studying the effects of "acid-soil" conditions, and more recently, of certain toxic substances, resulting from or accompanying soil acidity.

The presence of toxic concentrations of "active" aluminium salts in the acid, granitic soils under investigation has been studied (see HARTWELL and PEMBER). In this paper the author describes a method for the determination of "active" aluminium in acid soils.

A full account of the work of the station on aluminium toxicity to plants and its possible correction, will appear in a future publication from this station.

VII. — The biological role of aluminium and iron compounds is being studied by many investigators with special reference to the effects

of these metals: a) on acidity of soil; b) on the absorption of essential nutrients by plants; and c) on the functioning of the tissues of the plants after the metals have been absorbed. This paper considers only those effects upon the maize plants resulting from the absorption of these metals and the probable relation of these phenomena to the susceptibility of maize plants to root-rots.

One of the most characteristic differences between normally growing maize plants and those which become severely root-rotted, is the condition of the vascular plate tissues in the nodes of the stalks. The plants which become root-rotted are those which have the nodal tissues discolored and in various stages of disintegration. This disintegration of the nodal plate tissues begins in the absence of any specific organisms in the tissues.

The brown, yellowish brown, and brownish purple discolorations with their consequent disintegration which are frequently found in diseased plants have been produced artificially by injecting solutions of certain salts of aluminium and iron into the plants. Definite chlorophyll and leaf-tissue changes have been produced also.

The most severe cases of root-rots have been found in soils notable because of their deficiencies of lime and available phosphates. Such soils have variable quantities of salts of aluminium and iron available for absorption by plants.

The accumulations of aluminium in the plants are associated with retarded growths and increased susceptibility of certain strains to root-rots. When iron compounds gradually accumulate in the nodal tissues of the plants, the growth of the stalks may be little affected, but the disintegrations of the nodal tissues are accompanied by increased susceptibilities of the plants to root-rot.

When abundant aluminium injuries occur in the maize plants in certain fields, it is an indication that the soil is deficient in available phosphates.

VIII. — This paper is limited chiefly to the recent work on aluminium, which has been conducted in the United States. The author gives information on the work done in the following states:

Indiana, Massachusetts, Rhode Island, Illinois, Hawaii, Iowa, Utah, Alabama (experiments on manganese), Ohio and Wisconsin. He then gives a summary of concordant results, as follows:

Soluble salts of aluminium have been found by a number of investigators in acid soils which have been treated with soluble salts of other metals.

Aluminium in soluble form is found in soils where sulphur is being oxidized. Sulphuric acid and sulphates are present and act on the aluminium.

Calcium carbonate has been found to prevent the injurious action of aluminium. Aluminium associated with hydrolyzable and highly ionizable salts has been shown to exert a toxic influence on plants aside from the acidic effect of the associated acid radical.

Aluminium phosphates have been shown to be excellent sources of

phosphorus for a number of agricultural plants in spite of the aluminium present.

Soils that have not been treated with salts show practically no soluble aluminium in clear water extracts.

The form of aluminium first extracted by normal potassium nitrate in aqueous solution is non-diffusible and appears to be a colloidal form of aluminium hydroxide.

Practically all acid soils which have been studied contain quantities of easily replaceable aluminium when brought in contact with salt solutions.

Certain acid soils contain large amounts of soluble manganese and this element appears to support nitrification. Soluble manganese occurs in soils as a result of sulphate oxidation.

There is available information which indicates that the use of moderate amounts of liming materials and ample quantities of phosphates will precipitate the toxic forms of aluminium, iron and manganese, in acid soils and at the same time allow the establishment of pH values in keeping with the requirements of soil organisms, the growth and feeding power of crops and their response to feeding. It has been shown that attention to the above considerations makes possible the production of maximum quantities of nitrates and a large symbiotic nitrogen fixation.

Results requiring verification. Aluminium has not yet been shown to be a suitable base for the process of nitrification. Until this has been done, this biological process cannot be considered a primary cause of increasing soil acidity.

Soluble aluminium has been found to be present, where the bacterial oxidation of sulphur is in progress. The possibility that sulphate formation is a factor which contributes to an increase in soil toxicity is a subject for further investigation.

There is no analogy between nitrification and sulphate formation, either from the standpoint of the acidity endured by the organisms concerned, or the requirements for a base. The two processes may, however, be analogous with respect to the action of the ammonium salts produced, each giving rise to secondary decomposition with consequent production of soluble aluminium.

The influence of aluminium as a toxin to soil organisms does not appear to be important when optimum quantities of phosphorus, potassium and calcium are supplied. Studies concerned with this question have not been sufficiently extensive, to allow of a general conclusion, and other species of bacteria should be studied.

Aluminium hydroxide has not been found to be toxic under normal conditions of experimentation. However, the insoluble hydroxide cannot be considered as representative of the forms of aluminium which are likely to be met with under soil conditions. Since it is a weak base, its toxicity would appear to be related to its action in precipitating phosphorus and calcium in the soil solution and in the cells of plants and micro-organisms, and in the precipitation and formation of certain organic compounds which cause abnormal functioning of living cells. It may

also rob plants of potassium through losses by leaching of the potassium aluminate. Aluminium hydroxide or the hydrosol of aluminium hydroxide has been reported as the form of aluminium produced by replacement with salt solutions. The influence of the pH values on the solubility of this compound have shown that increasing quantities should be found with increasing concentration of hydrogen-ion below pH = 6 and that appreciable quantities of aluminium hydroxide are in solution at pH = 8 and above. Thus, the injury which is sometimes noted where hydrated lime or excessive quantities of carbonates have been applied may be due in part to the toxicity of the aluminium ion.

Points in need of immediate investigation. — The soluble but replaceable forms of aluminium, iron and manganese present in acid soils should be identified, in order that definite information may be available as to the origin of the toxic and acidic aluminium, iron and manganese. The recognised ability of many crops to feed on insoluble minerals makes it unnecessary to assume that aluminium must be in solution in order for it to be toxic to, or assimilated by, organisms.

The importance of optimum quantities of phosphorus and potassium in counteracting the toxic effect of these elements in the soil and in organisms needs careful consideration.

Organic matter has been neglected as a possible detoxicating factor with respect to the forms of these elements that depress the growth of organisms and plants.

In conclusion, it can be said that the gradual development of toxic conditions is generally accompanied by a gradual reduction of non-toxic available bases in the soil. The conditions are aggravated, as far as crops and organisms are concerned, by a scarcity of certain essential elements, particularly phosphorus and potassium.

D. v. S.

533. Life History of Azotobacter.

I. — LOHNIS, F. and SMITH, N. B., Studies upon the Life Cycles of the Bacteria, Part II, Life History of Azotobacter, *Journal of Agricultural Research*, Vol. XXIII, No. 6, pp. 401-432, 9 pl., bibl., Washington, 1923.

II. — HUNTER, O. W. Stimulating the growth of Azotobacter by Aeration, *Ibidem*, Vol. XXIII, No. 8, pp. 665-677, 4 fig. bibl. 1923.

III. — IDEM, Production of a Growth-promoting Substance by Azotobacter. *Ibidem*, Vol. XXIII, No. 10, p. 825-831, fig. 2, bibl., 1923.

IV. — IDEM. Protein Synthesis by Azotobacter. *Ibidem*, Vol. XXIV, No. 3, pp. 263-273, bibl., 1923.

V. — GAINES, P. L., On the Use of Calcium carbonate in the Nitrogen-fixation Experiments. *Ibidem* Vol. XXIV, No. 2, pp. 185-190, bibl., 1923.

In a preliminary communication published in the *Journal of Agricultural Research* Vol. 6, No. 18; pp. 675-702, 1916, the author pointed out that the life history of Azotobacter is much more complicated than was generally assumed, and that the same holds true with regard to all other bacteria. The correctness of this general statement was further demonstrated by the same author in a critical review of the bacteriological literature.

ture, published as Part I of these Studies (Studies upon the life Cycles of the Bacteria. Part I, Review of the literature 1838-1918. *Mem. Nat. Acad. Sci.*, Vol. 1, No. 2, 335 p.).

To obtain complete and actual information upon the life cycles of the bacteria is no more difficult, but takes much more time than to make an ordinary bacteriological diagnosis. Single-cell cultures and continuous microscopic observation of the living organisms are by no means so absolutely indispensable as is sometimes asserted. The usual methods of isolating, cultivating, and studying the bacteria are, as a rule, quite sufficient to collect complete information, provided they are applied judiciously and the investigator himself is not too pre-occupied by the widespread prejudices concerning "normal" and "abnormal" growth, "involution forms" and "contamination". A sufficient number of parallel tests, the frequently repeated microscopic control of the cultures, held for a sufficient length of time (not less than a month, preferably longer), and the regular repetition of all experiments are three points of major importance.

Tests made with 30 strains of *Azotobacter* and with several cultures of related bacteria have shown that only two species of *Azotobacter* are completely characterised thus far: *Azotobacter chroococcum* and *A. agile* Beij. (syn. *A. Vinelandii* J. G. Lipman). *A. Beyerinkii* J. G. Lipman is a variety of *A. chroococcum* and *A. vitreum* Löhnis, is probably a variety of *A. agile* — *A. Smyrni* C. B. Lipman and Burgess and cannot be accepted as a species; according to all marks ascribed to it by its authors it is the large sporulating growth type of *A. chroococcum* — *A. Hilgardi* C. B. Lipman and *A. Woodstownii* J. G. Lipman, both of which are incompletely described and should not be retained.

Each of the 30 *Azotobacter* strains was tested in about 100 to 200 transfers; the results presented in this paper are based on over 20 000 observations.

The thorough study of the problem of the life cycle of *Azotobacter*, led to the discovery that from every *Azotobacter* culture not less than seven different growth types can be developed and stabilised; all of them are interchangeable. These are: 1) Large non-sporulating cells; 2) coccoid forms; 3) dwarfed cell type; 4) fungoid cell type; 5) small non-sporulating rods; 6) sporulating rods; 7) large sporulating cells.

Identical with 2) are: *Micrococcus concentricus* Zimm., *Micrococcus suljureus* Zimm., Lehm., and Neum., and *Micrococcus roseus* (Bumm) Lehm and Neum. respectively.

Identical with 4) are: *Mycobacterium luteum* Söhngen, *Mycobacterium lacticola* Lehm. and Neum., *Mycobacterium album* Söhngen.

Identical with 5) are: *Bacterium lactis viscosum* (Adamez) Lehm. and Neum. and *Bacterium putridum* (Flügge) Lehm. and Neum.

Identical with 6) are: *Bacillus terminalis* Mig., *Bacillus jusiiformis* A. M. and Gottheil, *Bacillus pumilus* A. M. and Gottheil.

Identical with 7) are: *Bacillus luteus* Baker and Smith, *Bacillus petasites* A. M. and Gottheil, *Bacillus malabarensis* Löhnis and Pillai and *Bacillus danicus* Löhnis and Westerman.

All types of bacterial reproductive organs have been found with *Azotobacter*, namely: gonidia and gonidangia, regenerative bodies (zoospores etc.), arthrospores, microcysts, endospores and exospores. All these organs of reproduction are fundamentally not so different as might be assumed.

The formation of the symplasm and the regeneration of new cells from this more or less amorphous substance of varying stainability, proceeds with *Azotobacter* in the same manner as with all other bacteria.

Conjunction was regularly seen in young cultures before the formation of gonidia, regenerative bodies, and exospores and endospores took place. Part of the regenerative bodies are clearly zygosporos. The cell union is either temporary, effected by connecting beaks, bridges, or by direct contact of two or more cells, or permanent, due either to a sticking together of two uniform cells, which retain their identity, or to a coalescence of two cells of more or less different appearance. These various modes of conjunction, observed with *Azotobacter* as with other bacteria, resemble very closely those recorded with yeasts and with protozoa.

The fact that the different developmental stages of *Azotobacter* could be in part identified with certain so-called species belonging to the form genera *Micrococcus*, *Bacterium*, *Pseudomonas*, *Bacillus* and *Mycobacterium*, demonstrates anew and conclusively that the whole system of bacteria needs complete revision, which is to be based upon the results of thorough examination of the life histories of the bacteria.

The author has illustrated his paper with 9 photographic plates (108 figures) of microscopical observations, all carefully described.

II. — The theory of SÖHNGEN that the BEIJERINCK medium lacks only nitrogen and oxygen is here supported. Observations suggest that both these elements can be supplied by aerating the culture medium and that thereby a rapid and vigorous growth of *Azotobacter* can be promoted. Aeration also stimulates rapid nitrogen fixation by *Azotobacter*.

The ability of *Azotobacter* to fix nitrogen is dependent upon the energy derived from carbohydrate fermentation. In the aerated cultures the consumption of dextrose is very rapid. The presence of calcium carbonate is not essential in a medium used for aerating pure cultures of *Azotobacter*.

III. — It is maintained by many investigators that the animal cell is incapable of synthesizing vitaminines and that such cells are thus required to obtain their food accessories from the vegetable kingdom. If this is true, it can be logically asked, do plants need such growth promoting factors? If so, do they synthesize them or from what source are they obtained? The application of the vitaminine theory to microbical nutrition is now prevalent. PACINI and RUSSELL, from their experiments concluded that *Bacillus thyphosus* Eberth-Gaffky can manufacture vitaminines and likewise stimulate growth of the animal cell.

If a growth-promoting substance is a requirement for *Azotobacter* development, it is capable of manufacturing such. The *Azotobacter* can synthesize a food accessory factor. This food accessory factor stim-

ulated a greater net gain in white rats than did baker's yeast. Azotobacter exerts a pronounced curative effect upon pigeons effected with polyneuritis.

IV. — The high protein content of the Azotobacter cell and its relatively simple food requirements suggested the possibility of utilizing it as a means for synthesizing a protein which could be used either as a stock food or a fertilizer. The employment of this organism for such a purpose appeared to offer some important advantages on account of its nitrogen-assimilating ability. This would necessitate the use of a solution having a carbohydrate only as the important constituent. The protein content of Azotobacter growth obtained from a solid medium was found to be 11.81 %, while that collected from a liquid culture was 30.65 %.

The yield of cells increased with the quantity of dextrose in the medium. When molasses was used as a source of energy for Azotobacter development, there was obtained a yield of cells equal to 30.44 % of the sugar in the molasses. Azotobacter is able to convert the soluble nitrogenous substances present in molasses into more complex protein, as well as to utilize the molasses as a source of energy for the fixation of atmospheric nitrogen.

The addition of straw to the dextrose or molasses medium did not cause any appreciable increase in the quantity of nitrogen fixed.

V. — In reviewing the literature on nitrogen fixation by soil bacteria, the author was impressed with the great variety of media that have been employed by different investigators. The author calls attention to the difference caused by the presence or absence of calcium carbonate. He then describes media used by WINOGRADSKY, BEIJERINCK, LIPMAN, ASHBY, LOHNIS, and his students. It remained for STOKLASA to produce the necessary evidence for a correct understanding of the function of calcium carbonate in nitrogen fixation experiments by demonstrating quantitatively the formation of organic acids in cultures of Azotobacter.

The medium employed by the author had the following composition :

Mannite 20 gm., K_2HPO_4 0.2 gm., $MgSO_4$ 0.2 gm., $NaCl$ 0.5 gm. $FeCl_3$ trace and 1000 cc. water. Several hundred samples of soil from Kansas and other States have been examined. He concludes from his experiments that the quantity of nitrogen fixed in the presence of Azotobacter is greater than when it fails to develop. The number of soils capable of initiating the growth of Azotobacter under the experimental conditions here described is greater by 20 %, if calcium carbonate is added to the medium than if it is omitted. The quantity of nitrogen fixed in a medium containing calcium carbonate is, for practical purposes always equal to and in most cases greater than when calcium carbonate is not present in the medium. The presence of calcium carbonate exerts a greater beneficial effect upon those organisms, other than Azotobacter, that bring about the fixation of nitrogen, than upon Azotobacter itself.

D. v. S.

*Pedology.***534. Soil Structure and Colloids.**

HAGER, G. Bodenstruktur und Kolloidchemie. *Zeitschrift für Pflanzenernährung und Düngung (wissenschaftlicher Teil)*, Vol. II, No. 4, pp. 292-311, fig. 1. Leipzig-Berlin, 1923.

The chemistry of the colloids is a recent science, but it promises to become of great importance to agricultural chemistry and pedology.

The correction of soil structure by liming makes ploughing easier, and although the surface dries quickly, the lower layers of the soil retain water and remain moist.

Chili nitrate and potash salts bind together clayey soils making them more difficult to plough, and reduce their aeration and water-retaining capacity. Land flooded by the sea is rendered useless for years, even after the salt-water has been washed out by the rain. All the alteration in the soil which we have already mentioned, and also many others, are occasioned by changes in the colloids of the soil, viz., the soil particles which are in a colloidal condition.

Colloids are distinguished from suspensions and molecular solutions by the degree of their dispersion. The term colloid is confined to particles below 0.0002 mm. being called colloidal clay according to the nomenclature adopted by the International Commission. Among the colloids are classed the "gels", known in ordinary chemistry as aqueous silicates of alumina, and in colloidal chemistry, by the name of absorbant compounds.

The author draws attention to the fact that, in soil analysis, the determination of the size of the particles is not sufficient, for much depends upon whether the particles are flocculated "gels", or granular bodies.

All inorganic gels have a high water content, and readily absorb the hydroxyl ions. The author mentions in this connection the work of several authors such as ZSIGMONDY, KAPPEN, WIEGNTR, KING, MATTSON and others, and summarises their conclusions as follows:

The particles of granular structure disintegrate as a result of the various reactions that increase the degree of dispersion of the soil. The coagulated colloids, which often envelop the particles, are dissolved to some extent, but largely decompose and become gelatinous and viscous. Further, they absorb water. All these factors help to form the soil into clods which hinder ploughing.

Under the influence of all the factors that tend to diminish the degree of the dispersion of the soil, the coagulated colloids become granular, while the colloids present in the soil solution are coagulated. The particles are reduced in volume, and the structure of the soil is improved.

The author then reviews the causes believed to produce "peptisation" and "coagulation", but many questions connected with these subjects are yet unsolved.

It, however, remains a fact that lime and calcium carbonate improve

the structure of the soil, whereas neutral salts such as sea-salt, potash salts and Chili nitrate have a deleterious effect.

The effect of the ions seems to be much greater than has hitherto been supposed. Changes in electric potentials, superficial tension and chemical reactions are the causes of the phenomena of peptisation and coagulation. The author understands by adsorption, all kinds of reactions in which surface plays any part. The higher the degree of dispersion, the greater the surface extension and the greater the reaction of superficial molecules.

The alkaline bases and alkaline earths (Na OH , KOH , and Ca (OH)_2 , as well as their carbonates), are of considerable importance in the soil because they change the degree of dispersion as the result of the absorption of the hydroxyl ions by the colloids. The electric forces that come into play induce precipitation. Thus, liming makes the structure of the soil more granular.

Neutral salts, like Na Cl , and K Cl , have the contrary effect. The zeoliths of the soil contain much lime in an exchangeable form. Therefore when sodium chloride is introduced (by flooding with sea water), or potassium chloride (in a fertiliser), an exchange of bases will take place with the formation of sodium zeoliths that are very easily decomposed. Afterwards, soluble compounds quickly removed by the rain are formed, and the soil becomes hard, impermeable and caked. As a result of the degree of dispersion being increased, hard-pan may be produced. In the opinion of the author, it is not the magnesia present in the potash fertilisers that produces these crusts, as is commonly supposed.

Nitrate of soda may have the same injurious effect as the above salts. The plants absorb the nitrogen and leave the soda which forms sodium carbonate, a solvent of humic substances. In this case also, the degree of dispersion is increased, and the structure of the soil is altered for the worse.

D. v. S.

535 Removal of Salts from Soils in Egypt.

MOSSERI VICTOR M. and AUDEBEAU BEY. CH. Du rôle des crevasses du sol dans le dessalement et l'assainissement permanents des terres d'Égypte. *Sultanic Agricultural Society, Bulletin*, No. II, p. II, Plates 4. Cairo, 1923.

M. MOSSERI has shown in a previous paper (*Le drainage en Égypte, Bulletin de l'Institut Egyptien*, 1909), that when more or less saline soils crack and become fissured under the action of heat and drought, the salts they contain are concentrated to a great extent on the surface of the clods while the fissured parts behave like rocks that are permeable on a large scale. These facts explain why it is better in the case of soils that crack, to remove the salt by means of open ditches rather than by under ground pipes (or drainage properly so-called).

During the *sheragi* period (the hot months), the soil cracks and fissures in all directions, thus making deep channels that form a complete and natural system of aeration as the air passes down them to considerable depths, and is distributed along vertical and horizontal planes.

Flood Basins. — For several thousands of years, the whole of Egypt was irrigated by flood-basins which became full of *red water* during the months of the annual rise of the river, and emptied themselves either into the Nile itself, or into the lakes bordering the Mediterranean, before the winter crops (cereals, leguminosae, flax, etc.) were sown, that is to say, at the end of October, or the beginning of November. The water remained in these basins for 50 to 70 days, and usually reached a depth of 1.50 m.

During the XIX century, however, irrigation by flood basins was abandoned in the Delta and became superseded by perennial irrigation. In Middle Egypt, the construction of the Assouan reservoir led to the conversion of part of the basins early in the XX century, but the old irrigation system still exists in Upper Egypt. In these basins the precipitation of matter in suspension in the water naturally takes place in decreasing order of its density, so that the soils furthest from the river are generally the most clayey, some of them containing as much as 90 % of clay.

Temperature of the air and soil. — The author gives a table showing the average temperatures of air and soil in the Delta, Middle Egypt and Upper Egypt respectively during the period intervening between the time when winter crops are carried (April-May) and the date of the annual rise of the Nile (August-September).

Maximum temperatures of air 34°-40°C

Minimum temperatures of air 16°-25°C

Maximum temperature of air at surface of soil 55°-70° C. The highest temperatures are found in Upper Egypt. The average evaporation in 24 hours for the same period varies from 4 ½ mm. to 13 ½ mm. (Wild's evaporimeter).

Level of subterranean water. — In Upper and Middle Egypt, the natural level of the subterranean water remains very low from April to August (about 4 to 5 metres below the soil in April, and from 5 to 7.50 metres towards the end of July). This depth decreases on passing from Cairo in a northerly direction. In the northern districts, the natural water-table remains at a considerable depth in the subsoil, whereas the artificial water level due to the lack of any soil slope is met with quite near the surface (0.50 m. to 1.20 m.).

Fissuring of the soil. — Although the soils of Upper Egypt are less clayey than those of the north of the Delta, they contract more under the influence of higher temperature, more intense evaporation and the lower level of the water-table. The cracks assume polygonal figures on the surface, their depth varies from 0.25 m. to 1.50 m. These fissures grow increasingly narrow and give rise to channels ramifying in all directions, which become reduced to the width of capillary tubes. In 1918, the author had the width and depth of 52 large fissures over an area of 15 sq. metres measured every 5 days in the region of Sakha (centre of the Delta). These measurements showed that the fissures increased much less in depth than in width from May to July. The maximum depth is practically reached in the second half of May.

The river water contains in solution a large amount of salts, chiefly chlorides, the salt content is at its minimum during the annual rise of the river (120 to 125 mg. per litre, 2.5 to 3.5 mg. being chlorides), and attains its maximum when the Nile is at its lowest (235 to 260 mg. per litre, of which 20-26 are chlorides). Although the percentage of injurious salts is very little at the time the basins are filled it would, however, render the soil completely sterile in the course of years unless the salts were leached out and carried away to the sea. The soils are freed from salts by the epipolyhydric and bathyhydric processes.

The water-holding capacity of ordinary, dry alluvial soils varies in volume from 50 to 55 %; when these same soils are saturated, the volume of water they contain ranges from 60 to 65 %. Some of this water passes down slowly into the subsoil and takes its course to the sea, either directly, or by way of the Nile, when the level of that river is sufficiently low. This is the bathyhydric process. The water in its passage through the soil dissolves the salts along its course and thoroughly washes the soil. The salt content of such water is much higher than that of Nile water (See V. MOSSERI, *l'Utilisation du réservoir souterrain de l'Égypte*, *Bulletin de l'Inst. Égyptien*, Series V, Vol. VIII). In the northern part of the Delta, the soil cannot be washed by the bathyhydric process, since the strata of plastic clay prevent there being any communication between the upper soil and the deeply-seated sands. In the centre and south of the Delta, as well as in Middle and Upper Egypt, the leaching is more thorough because the alluvium is more permeable. In regions where perennial irrigation has replaced the basin system, the permeable soil is not so well washed.

The water that is not lost in the deeper strata remains in the soil whence it is abstracted by plants, or liberated by evaporation. The water moves by capillary attraction, and on reaching the surface of the ground, or the sides of the fissures, evaporates leaving behind it the salts, and especially the chlorides. The amount of salt per unit of surface area becomes very large on these surfaces.

Subsequently, during the filling of the basins, the injurious salts are dissolved in a large volume of water and conveyed to the Nile as soon as

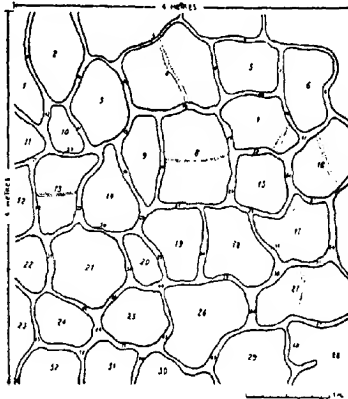


FIG. 99. — Soil crevices in the Sakha area measured in 1918.
(intervening crevices not included).

the basins empty themselves; this process is termed epipolhydric (because the salts are carried to the surface). In fissured soils, the fissures play a diaclastic part.

The fissures of the soil have been of incalculable assistance in the continual removal of the salts for many centuries. To this leaching process it is due that the northern portion of the Delta which is now deprived of its ancient rights owed its fertility, while the Northern regions of Lower Egypt were destined to sterility when a vigilant administration no longer supervised the correct method of water distribution. Since the suppression of the flood-basins first throughout all Lower Egypt, and later in part of Middle Egypt, the soil fissures have no longer been able to carry out the whole of the work that formerly devolved upon them.

As the salts cannot now be removed from the surface in the low-lying northern regions of the Delta, recourse will have to be had to mechanical draining, but before the system of drainage to be adopted can be decided upon, it will be necessary to study carefully the bathhydric and epipolhydric processes.

D. V. S.

536. The Soil of Egypt Under the Flood-Irrigation System.

MOSSERI VICTOR, M. *Sultanic Agricultural Society. Bulletin* No. 12, pp. 1-41 diagram 1. Cairo, 1923.

The decreasing yield of crops in Egypt during the last twenty years has given rise to serious uneasiness, and the poor returns do not compare with the yields reported to have been obtained from the Nile soils under the ancient system of flood irrigation. Amongst contemporary writers there are, however, some who deny the truth of this legendary productiveness and support their view by the contention that the chemical composition of the Nile mud is the same as that of a soil of average fertility in Europe (See GAY-LUSSAC, *Du sol Egyptien*, 1885, and LUCAS, *Soil and Water of the Fayum Province*, Cairo, 1902).

Under the old system of irrigation basins, the soil was only worked in winter, the cultural operations (*cheloni*) being carried out as soon as the flood waters retired. In the rotation, cereals, or flax, were always grown in turn with legumes. After the winter crop was carried, the land remained fallow, exposed to the heat and drought (*shragi*) until it was irrigated by the rise (*tafi*) of the Nile. Under this system, the soil was never ploughed; the surface was lightly marked in some cases, but no fertilisers were applied and the same crops were raised every two years, however, the annual yield proved regular.

The truth of the matter is, that the mud has not yet been studied, and until this is done, there is no sufficient evidence to warrant the denial of the truth of the age-long belief that appears to be justified by practical results. Further though the water, or the mud, are not strictly speaking nitrogenous, phosphatic, potassic, or lime fertilisers and the mud may be no richer in manurial compounds than ordinary soil, it does not follow that the water and mud are inert substances without any fertilising action, for it is very possible that they contain elements which are useful from

the chemical, physical, or biological, standpoints. Further, the Nile water carries in solution salts capable of stimulating plant growth and preventing the formation of black alkali (*Journal of Agricultural Research*, Vol. XXI, p. 277).

The water deposits a mixture of sand and clay in the areas where the proportion of sand is large, so that *Orobanch* develops and makes it impossible to cultivate beans. (See MOSSERI, *Observations sur les orobanches*, 1903). On the other hand, where the deposit consists mainly of clay, the soil forms fissures in the summer and is completely free from broomrape. The depth of the alluvium also decides the crops to be grown. Sandy deposits are entirely occupied by *Cucurbitacea* (water melons, mel-

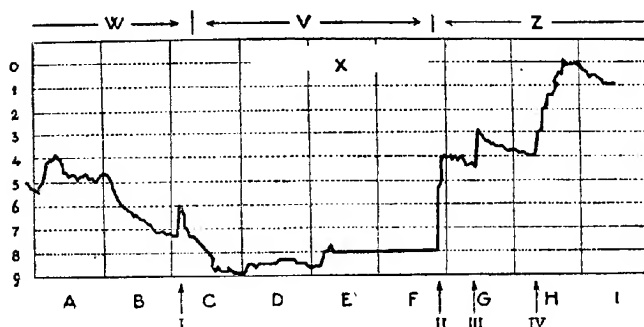


FIG. 100. -- Contraction and cracking of the soil *in situ*.

W = Wheat	I = Casual irrigation
V = Sheragi	II = Tañ-Sheragi
Z = Bersim	III = Labour
X = Soil level	VI = Sowing time-Bersim
A-I = March-November	

ons etc.). On the siliceous-clay alluvium, barley and wheat thrive, while the clays are suited to all crops. Bersim (Alexandrian clover), is cultivated on deposits (not exceeding $\frac{1}{2}$ m. in depth). Thicker layers are left fallow for a whole year.

The *Sheragi*. — After the winter crops are carried, the bare soil is left exposed for many months, and as a result of the action of the heat and drought, becomes traversed in all directions by cracks and fissures (1).

Effect on the physical properties of the soil. — The degree of fissuring depends upon the amount of shrinkage. It was formerly believed that the contraction of soil under the drying out process depended solely upon its content of colloidal clay. (H. A. TEMPANY, *Journal of Agricultural Science*, 1917, p. 312). Recent experiments, however (T. G. MASON, *West*

(1) See No. 535 of this *Review*

Indian Bulletin, Vol. XIX, 1922, p. 126) would appear to prove that linear contraction is regulated by two opposing factors: 1) the amount of the dispersion of the soil particles which determines the amount of moisture present at the maximum degree of plasticity; 2) the extent of the aggregation of the particles which depends on the proportion of this moisture that evaporates when the shrinkage ceases.

The fissuring of the ground was one of the most efficient factors in maintaining soil fertility under the old system of basin irrigation. The advantages of the *Sheragi* are manifold; it regulates the removal of the salts, while the fissures carry down the air to considerable depths where it circulates owing to the differences in the temperature. The deep cracks make the ground porous during the *Sheragi* period, the volume occupied by the air in the soil increasing at least 35 to 40 %. This volume may reach, or exceed, the values found in the case of soils artificially broken up by the plough. The *Sheragi* allows the flood waters to penetrate to a great depth in the soil, but it also insures their rapid and regular distribution, as well as making it possible for the soil to store up a large quantity of water. Rain and artificial irrigation cause the soil to cake gradually (see diagram), which renders infiltration difficult and checks the distribution of moisture. The more clayey the soil, the greater its tendency to cake, and the conditions favourable to plant growth would become increasingly difficult to maintain were it not that the *Sheragi* restores them by breaking up the ground. The clay deposits are frequently so compact that they cannot be cut by plough, in which case they are left until the *Sheragi* has rendered them mellow and in a condition for working after the next inundation.

Effect on the chemical properties. — The air circulating in the depths of the earth makes it possible for oxidation processes to take place. In the sub-soil of low-lying, badly aerated ground, the alkaline bicarbonates become transformed into carbonates, but aeration produces the inverse reaction. Under the influence of heat, the colloids investing the minerals become dehydrated and disintegrated, with the result that solutions richer in nutritive substances are produced.

Effects on the biological characters. — Heat and drought have a considerable effect on the amount of nitrification taking place. (See Sir JOHN RUSSELL, *Soil Conditions and Plant Growth*, 4th ed. London, 1921, p. 169). Soils that have been subjected to the action of *Sheragi* show, when once they are irrigated, a more marked bacterial activity than other soils of the same character. *Sheragi* would appear to exercise an effect similar to that produced by partial sterilisation (See PRESCOTT, *A Note on the Sheragi Soils of Egypt. Journal of Agricultural Science*, Vol. X, 1920, p. 177). The improvement produced by partial sterilisation is permanent lasting more than 200 days; it is especially noticeable when the heat is accompanied by continued dryness.

Effects on parasites. — It is certain that the action of the heat and the drought of the *Sheragi* destroy the spores, or eggs, of most of the vegetable, or animal, enemies of cultivated plants. This is of great importance in the case of a valuable crop like cotton which is liable to wilt disease, and root-rot. The *Sheragi* also destroys the vegetation sheltering these parasites.

Inundation. — The average volume of water absorbed per "feddan" in the basin region during an ordinary year has been estimated at 3.950 cubic metres; but the total layer of flood water absorbed by, and evaporated from, these basins is about 1.36 m. which is equal to a total volume of 5.700 m. per "feddan". This is the volume that must be taken as a basis in calculating the amount of substances in solution, or in suspension, that are removed by the water. Submergence does not appear to affect the work of the *Sheragi* to any appreciable extent.

Conclusions. — Since the flooding system has been suppressed, the conditions of production have been profoundly altered and fertility has been progressively affected. The two-years' rotation of the present day has reduced the duration of the *Sheragi* and thereby decreased its advantages. Although economic conditions do not allow of a reversion to the old system, it is necessary to reconcile modern requirements with the necessity of prolonging the *Sheragi* period. The problem can only be solved by a three-years' rotation combined with a careful selection of the crops to be grown. The three-years rotation approaching most nearly to the former conditions would be a system by which after a long summer *sheragi*, *chetoni* cereals follow *bersim*, or some other leguminous crop, of the preceding winter, the rotation being *cotton*, *bersim* (or some legume) — *winter cereal* (wheat or barley), *maize*, *cotton* etc. With this rotation, the winter legumes would be sown after the cotton was gathered or even before the latter was pulled up, if the season were advanced and the leguminous crop were *bersim*. The land is then left bare until the *chetoni* cereals (wheat, barley, etc.) are planted. They can be sown at the proper time in soil rich in nitrogen and thoroughly prepared, as it has been exposed to the beneficial effects of a *sheragi* period of the same length as in the days of basin-irrigation. In districts where rice and sugar-cane are cultivated, special rotations are needed. The advantages of the above rotation are great; it allows the soil to be thoroughly prepared; a complete *sheragi* succeeds one, or two, partial *sheragi*; further, the seeding can be done at the right time. To sum up: soil fatigue is eliminated, the soil is drained and its fertility maintained with the minimum work and expense, labour is considerably reduced, and fewer draught animals are required for agricultural operations; more cattle can be raised, which increase the production of meat, milk and other dairy produce, and also of farmyard manure; weeds and the agents of disease are destroyed. In addition, this system reduces the water-requirements of Egypt which is an immense gain, for the water-supply of the country presents a serious problem that is the subject of much discussion at the present day.

D. v. S.

537. Condensation of Water in the Soil.

JAGER GÖRLINGS. Condensatie van water in den boden. *Tydschrift der Nederlandsche Heidemaatschappij*, Year 35, No. 9, pp. 314-316. Arnhem (Holland), 1923.

With a view to the reafforestation of the moving sands of Holland, the Sylvicultural Experiment Station of that country has recently estab-

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lished a Sub-Station at Stroe (Holland) where experiments are to be carried out on the economy of water in a sandy homogeneous soil of low water-retaining capacity. In the course of these investigations, which are to be continued for some years, it was discovered accidentally that, under certain conditions, water can be condensed and conducted deep down into the ground.

The experiments were carried out in the following manner: 18 boxes (1.5×1.5 and 1 m. deep), were filled with sand (the surface layer in some cases being mixed with clayey soil, lupin straw, or heather), and planted with two-year-old pines.

The surface of some of the boxes was covered, and that of others left exposed. The boxes could easily be placed on a balance. From May 20, 1922, the temperatures of the soil have been taken daily and it has been found that covering the soil has a great effect on temperature variation. These variations were particularly noticeable when the sand was covered with gravel. During a long period when the boxes, were not watered, it was found that while the weight of some of the boxes had decreased, that of the others had clearly increased, the gain in weight being especially marked when the sand had been covered with gravel, though both the boxes that were left uncovered and those in which the upper layer contained lupin straw were also heavier than at the outset of the experiment. This increase in weight must be due to the condensation of water in the soil caused by the rapid cooling of the gravel, and of the upper layer of the sand upon which the water collected. This experiment is likely to be of great importance in the reforestation of shifting sands. D. V. S.

538. Shrinkage of Clays and Soils.

HARDY F. (West Indian Agricultural College, Trinidad). *The Journal of Agricultural Science*, Vol. XIII, No. 3, pp. 243-261, Bibl. Cambridge, 1923.

The shrinkage coefficient of a soil may be defined as the maximum percentage decrease in length (linear coefficient) or in volume (cubical coefficient) which is shown by a block of the soil that has previously been worked up with to a standard degree of plasticity and then allowed to dry in air.

The author gives a brief outline of the researches of certain workers in the British West Indies on the significance of the shrinkage coefficient of clays and soils; one of the aims of these investigations being to examine the relationship between the shrinkage coefficient and the clay content of soils.

The author criticises TEMPANY's hypothesis which explains shrinkage as due to contraction consequent on loss of water by evaporation from the saturated gel-skeleton that ramifies throughout a mass of soil at its point of maximum plasticity. This hypothesis fails to account for the abnormally low shrinkage coefficients exhibited by lateritic soils, notably the red upland soil of Barbados. MASON explained this abnormality by assuming that kneading does not entirely destroy aggregation of soil particles, which is especially well marked in the Barbados red soil. The author showed, however, that

soils of similar colloid content and belonging to one and the same geological type, but showing different degrees of aggregation, possess similar shrinkage coefficients. He therefore sought a different hypothesis to explain soil shrinkage. His own hypothesis is based on the belief that colloidal gels possess a reticulate structure. At the point of saturation, a hydrogel probably contains water in two phases. The first of these is absorbed in the walls of the gel, and represents the moisture content at the hygroscopic coefficient stage. The second phase fills the vesicles of the gel, and is a crystalline phase.

The shrinkage in clays and soils is due solely to loss of vesicular water. Loss of water during the later stages of the shrinkage is accompanied by intrusion of air into the vesicles.

Variations in the shrinkage coefficients of soils of similar colloid content, but belonging to different geological types, are probably due to specificity in soil colloids. This shows itself chiefly in differences in the ratio of absorbed (hygroscopic) water to vesicular water. Red lateritic soils, rich in aluminium hydrogel, appear to possess relatively low vesicular water contents and in consequence, to have low shrinkage coefficients.

The author discusses the physical basis of the assumption that the "water content at the point of maximum plasticity" represents the imbibition capacity of a clay or soil. This constant may be accepted provisionally as marking an important stage in the water relations of clays and soils.

D. v. S.

539. Soil Acidity an Ecological Factor.

KELLY, A. P. *Soil Science*, Vol. XVI, No. 1, pp. 41-54, tables 4, figs. 2, bibliography. New Brunswick, U. S. A., 1923.

The study of soil extracts indicates that a soil of a particular locality has a more or less definite pH value and that the plants found on that soil usually have a preference for that hydrogen-ion concentration.

The author found that a general average pH could be assigned to areas of each loam, and that there was correspondance between degree of fertility and pH value. This pH value varies at different times of the year, to the extent of pH 1.0 during the growing season, hence plants growing in these places cannot be seriously affected by small variations in acidity. Acidity was found to increase to a depth of 15 cm. and then to decrease, the increase being greatest in the most sterile soils.

A list of plants growing on certain soils is given. Excessive drying in droughts was accompanied by increased acidity, which was lessened by heavy rains; acidity increased also during freezing. Absorbing roots were found chiefly in the least acid portions of the soil, associated with mycorrhiza in the top 15 cm. of more acid soils, these fungi becoming less abundant as acidity decreased.

Soil acidity, apparently has a different significance for different species, but is an important ecological factor in plant growth.

W. S. G.

540. The Hydrogen-Ion Concentration of Heavy Alkaline Soils.

JOSEPH, A. F. and MARTIN, F. J. (Wellcome Tropical Research Laboratories, Khartoum). *The Journal of Agricultural Science*, Vol. XIII, part 3 pp. 321-332, bibl. Cambridge, 1923.

In connection with the systematic examination of the soils of the Sudan, the hydrogen-ion concentration has been determined of a large number of samples taken from a wide area, and with a single exception, all those examined up to the present have been alkaline, the pH value being invariably over 8 and often over 9.

The present article deals with the methods used in this work (the electrometric and the indicator methods; the determination of the pH of soils, the preparation of the soil suspension of extract) and the effect of varying conditions on soil reaction (effect of varying the proportions of soil to water; combined effect of time of extraction and proportion of water; disturbing effect of nitrates; effect of electrolytes; residual effect of electrolytes in the soils; the drying of alkaline soils).

The details of the technique materially affect the results obtained and it is considered essential that they should always be specified in giving numerical results, which otherwise cannot be used for comparison with those obtained by other workers.

D. v. S.

541. The Fixation of Phosphoric Acid by the Soil.

FRAPS G. S. *Texas Agricultural Experimental Station Bulletin*, No. 304, pp. 5-22, tables 16. Brazos County, Texas, 1922.

The author studies the relation of fixation to properties of typical Texas soils, especially with reference to the loss of phosphoric acid of fertilisers.

It was shown that fixation of phosphoric acid increased when temperature increased, and when the time of contact with a soil was lengthened. Ignition of the soil raised its power of fixation, even after removal of the lime by acids. Soils having a fixing power of more than 50 %, lost practically no phosphoric acid when treated with acid phosphate and subjected to percolation. Soils with less fixing power than 50 % lost fertiliser phosphoric acid considerably, by percolation. Heavy rains would be necessary to cause loss of phosphoric acid under natural conditions; 3 to 4 inches of rain in 10 days might cause a loss of 3 to 4 % of water-soluble phosphoric acid on a sandy soil with fixing power less than 50 %. An examination of 761 soils and 561 sub-soils showed that increases in the percentages of iron and aluminium oxides gave increase power of fixation of phosphoric acid. A table is given showing the relative fixation of 1413 Texas soils.

W. S. G.

542. Biochemical Sulphur Oxidation as a Means of Improving Alkali Soils.

JOFFE, J. S. and McLEAN, H. C. *Science*, Vol. LVIII, No. 1490, pp. 53. Lancaster, Pa., 1923.

A number of suggestions have been made for the improvement of

alkali soils, such as leaching out the soils, or treating with gypsum to convert the carbonates and bicarbonates to sulphates.

LIPMAN has recently suggested a biochemical method by which sulphur is oxidised by micro-organisms and the carbonates converted into sulphates by the sulphuric acid produced in the soil, the soluble salts then being removed by leaching.

The experiments showed that the physical condition of the soil was greatly improved by the treatment and the subsequent rise in bacterial numbers was very marked.

The investigations are summarised by the authors as follows :

- 1) sulphur oxidises rapidly in the early period of incubation ;
- 2) the acid produced coagulates the colloids, destroys the impermeability of the soils and thus allows leaching to take place ;
- 3) indications point to the possibility of making productive, alkali soils of the most hopeless character, by treatment with sulphur followed by leaching.

W. S. G.

Fertilisers and Manures.

543. The Solution of the Problem of Chemical Soil Analysis from the Manurial Standpoint.

MITSCHERLICH E. A. Die Pflanzen-Physiologische Lösung der Chemischen Bodenanalyse. *Landwirtschaftliche Jahrbücher*, Vol. LVIII, No. 4, pp. 601-617, figs. 6. Berlin, 1923.

This article, which follows two similar articles by the same author (*Landwirtschaftliche Jahrbücher*, Vol. I, VI, pp. 71-92, 1921, and *Landwirtschaftliche Jahrbücher*, Vol. LVIII, No. 1 pp. 125-158 1923) (1), deals the problem of the chemical analysis of soils, cultivated plants being used as indicators. The author bases his work on the law of the influence of growth factors (*Wirkungsgesetz der Wachstumsfaktoren*) as previously set out by him. By the application of this law (pot cultures), it is possible to determine with great exactitude the amounts of nutritive substances, assimilable by plants, that are present in the soil.

The author recalls the fact that the effective value of one factor influencing growth is constant. This law is expressed by the logarithmic equation :

$$\log (A-y) = \log (A-a) - Cx$$

In this equation A represents the maximum yield obtainable with a certain nutritive substance ; y is the yield obtained by adding the quantity x of this substance ; c is the effective value ; A is the yield obtained without the addition of any nutritive substance to the soil, for by giving x the value of 0 we obtain $y = A$.

This yield A is determined by the amount of the same nutritive substance that was already present in the soil. Assuming the return A to

(1) See No. 547 of this Review. (Ed.)

be obtained by the amount of the nutritive substance b , we get the following equation.

$$\log. (A - a) = \log. (A - C. b) (2)$$

Substituting this value in the equation (1) we get:

$$\log. (A - y) = \log. A - c. b - c. x.$$

$$\text{or: } \log. (A - y) = \log. A - c (x + b) \quad (3)$$

The amount b is present in the soil in a form equivalent to the fertiliser x and determines the minimum yield.

The author grew oats in zinc pots lined with paraffin wax. He used for each pot as a basal fertiliser:

4.0	gm.	tribasic calcium phosphate
1.836	gm.	magnesium sulphate
0.5	gm.	sodium chloride
6.6	gm.	sodium nitrate

As a control fertiliser, he chose potassium sulphate. Under these conditions, that is to say, taking into consideration the surface of the pots and the secondary application of sodium, the effective value of the potash was 3.

The pots held 6 kg. of dry soil. The author first used a pure sand ("Grubensand"), and afterwards two calcareous soils (from Fischhausen and Quandtitten), mixed with the sand. In the preliminary experiments, these soils did not act upon a potassic fertiliser.

Results of experiments.

TABLE I.

Soil: 6 kg. of sand
yield y as function of potassic fertiliser x .

Potassic fertiliser x	a) Yield grain		b) Yield straw		c) Total yield	
	found	calculated	found	calculated	found	calculated
0.00	5.5 \pm 0.4	5.7	10.9 \pm 0.4	11.3	16.3 \pm 0.7	17.0
0.10	12.3 \pm 0.3	12.2	22.3 \pm 0.3	21.2	34.4 \pm 0.6	33.4
0.25	16.0 \pm 0.3	16.6	27.3 \pm 0.3	27.6	42.4 \pm 0.7	44.1
0.60	18.2 \pm 0.4	18.8	29.6 \pm 0.6	30.7	47.8 \pm 0.8	49.5
1.50	19.4 \pm 0.4	19.0	31.3 \pm 0.1	31.0	50.8 \pm 0.4	50.0

a) $\log. (19 - y) = \log. 19 - 5 (x + 0.052).$

b) $\log. (31 - y) = \log. 31 - 3 (x + 0.066).$

c) $\log. (50 - y) = \log. 50 - 3 (x + 0.060).$

This experiment shows that in this soil (6 kg. of sand) there were 0.06 gm. of potash in an assimilable form for oats (1 mg. K in 100 gm. sand).

TABLE II.

Soil: 5.5 sand 0.5 kg. calcareous soil:
yield y as function of the potassic manure x .

Potassic fertiliser x	a) Yield grain		b) Yield straw		c) Total yield	
	found	calculated	found	calculated	found	calculated
0.00	7.4 ± 0.6	9.1	13.5 ± 0.6	15.4	20.8 ± 1.1	24.5
0.10	14.9 ± 0.9	15.0	22.5 ± 1.0	22.7	37.5 ± 1.6	37.7
0.25	20.7 ± 0.4	18.9	29.9 ± 0.8	27.4	50.6 ± 1.1	49.3
0.60	20.3 ± 0.7	20.8	29.0 ± 0.6	29.8	49.3 ± 1.1	50.6
1.50	20.2 ± 1.9	21.0	32.1 ± 2.2	30.0	49.3 ± 4.1	51.0

a) $\log. (21 - y) = \log. 21 - 3 (x + 0.0823)$.

b) $\log. (30 - y) = \log. 30 - 3 (x + 0.1045)$.

c) $\log. (51 - y) = \log. 51 - 3 (x + 0.0951)$.

If 6 kg. of sand contain 0.06 gm. of potash, 5.5 kg. should contain 0.055 gm. As according to table II, 0.095 gm. were found, the remainder, 0.040 gm., potash, were contained in the 0.5 kg. of added soil. Therefore, 100 gm. of calcareous soil should contain 8 mgm. of potash. The author repeated the experiment with the following mixtures:

Table III; soil, 5.0 kg. sand + 1.0 kg. calcareous soil.

Table IV; soil, 4.0 kg. sand + 2.0 kg. calcareous soil.

Theoretically, we should find in the case of table III:

for 5 kg. sand, 0.05 gm. potash
" 1 " calcareous soil 0.08 " potash

Total 0.13 gm.

But the actual figures for c given in table III are:

$$\log. (57 - y) = \log. 57 - 3 (x + 0.130).$$

There is a similar discrepancy in table IV:

Calculated amount 0.20 gm. potash

actual amount found for c

$$\log. (55 - y) = \log. 55 - 3 (x + 0.20).$$

The author afterwards gives in 3 other tables, the results of his experiments with another soil (that from Quandtitten), which also thoroughly prove his theory.

The same type of experiments made with superphosphate did not, however, give the required results. This is attributed by the author

to the action of the calcareous soil upon the superphosphate which made the effective value of the fertiliser inconstant.

Since the effective value of nitrogenous fertilisers is constant (See : *Landw. Jahrb.*, Vol. LVIII, pp. 125-158), these manures can be used for determining the nitrogen assimilation in different soils according to the method adopted in the above experiments. D. v. S.

544. The Value of Mud.

ARNHOLD, F. (Institute of Agriculture of the University of Leipzig, Germany). Ueber die Bedeutung des Schlicks als Mittel zur Pflanzenernährung und Bodenverbesserung. *Landwirtschaftliche Jahrbücher*, Vol. 58, No. 2, pp. 205-250. Berlin, 1923.

The mud spoken of in this article is a deposit formed at the river mouths of North-West Germany and along the coast, composed of clay, sand, calcareous and humic substances containing débris of organic origin. When freshly laid down, this mud is dark blue and somewhat plastic, later, it becomes more friable and greyish in colour. In the neighbourhood of its deposition, this sediment has long been used for improving poor land. It is especially suited to leguminosae, but has also been employed successfully as a fertiliser in the case of cereals, roots and meadow clovers.

The *mechanical composition* of the mud varies very greatly according to its formation. It has been found to contain 5 to 65 % sand, and 85 to 35 % clay.

Its *mineral composition*, on the other hand, is surprisingly uniform. This mud regularly contains about 7 % calcium, about 0.8 % potash, about 1.8 % magnesia, 0.2 % phosphoric acid and 0.5 % nitrogen.

The sea-mud may be said to be chemically composed for the most part of colloidal silica, clay and humic substances. It contains a remarkable number of algae, especially of diatoms, and as the frustules of the latter, together with shells, make up 5 % of the mud, it is rich in silica and calcium carbonate which promote bacterial development.

The organic remains, as well as the clay, calcium, and silica have a favourable action upon soil dressed with this mud, but the chief manurial value of the mud consists in the *large number of bacteria it contains*. The author found free-living forms of these micro-organisms, such as *Azotobacter*, *Radiobacter* etc., bacteria living in symbiosis with green plants, and sulphur bacteria as well as those forms which decompose organic matter with the formation of ammonia. The nitrifying bacteria, *Nitrosomus* and *Nitrobacter* were especially numerous. The latter is not destroyed by the ammonification bacteria. It is true that loss of nitrogen due to the action of denitrifying bacteria occurs in the recently deposited mud, but after some time, all these bacteria perish with the sole exception of *Bac. fluorescens liquefaciens*.

The good results obtained with this mud are to be attributed to three factors: 1) the improvement of the physical composition of the soil; 2) the increase of nutritive substances; 3) the introduction of very active bacteria. The last factor is of special importance, as it renders super-

fluous the application of any nitrogenous fertiliser. The mud is used for poor land at the rate of 80-100 m³ per hectare, 80 kg. of potash and 100 kg. phosphoric acid being also applied.

Mud suspensions, can be used for inoculating the seed of leguminosae in order to assist the formation of root-nodules.

The author strongly advocates the employment of this mud on a large scale, especially in the case of uncultivated land that has been cleared. The reclamation of such land is at present a question of the greatest importance in Germany.

D. v. S.

545. A Comparison of Magnesians and Non-Magnesian Limestone.

LIFMAN, J. G., BLAIR, McLEAN and PRINCE, (New Jersey Agric. Exp. Stations). *Soil Science*, Vol. 15, No. 4, pp. 307-328, bibliography Baltimore, 1923.

In 1908 an experiment was started to test two sources of lime applied in different amounts and in connection with different crop rotations.

The materials used were magnesian (dolomitic) and non-magnesian limestones, each applied at the rate of 1000, 2000 and 4000 pounds per acre, and in the season of 1922, three 5-year periods have been completed.

The author describes every rotation in detail. His general conclusions are the following:

With few exceptions the lime-treated plots have shown substantial increases in crop yield over the check plots. The legumes have shown a greater response than the non-legumes. In most cases the 1-ton application has given some increase over the ½-ton application but this increase is not sufficient to justify the additional expense. The 2-ton application is excessive from the standpoint of economy. There was indication of crop injury from the use of 4000 pounds of magnesian limestone per acre. Aside from this the two forms of limestone gave results that are quite similar with a slight difference in favour of the magnesian limestone.

In the matter of the amount of nitrogen recovered from the crop, the difference between the unlimed and limed plots is more striking than the differences in the case of the crop yields. In this case, also, the magnesian limestone seemed to show a slight advantage. For the legume crops especially, the limed plots showed a higher percentage of nitrogen in the dry-matter than the non-legume crops. This clearly indicates an improvement in the quality of the crop as well as an increase in the quantity. There is evidence that the magnesian limestone favours nitrogen fixation rather more than calcium limestone.

The hydrogen-ion concentration decreased gradually as the lime applications were increased. The results of these experiments show that it is not necessary to fully satisfy the lime requirement of the soil (VEITCH-method) as commonly expressed, in order to get good results with most farm crops.

The nitrogen content of the soil has remained fairly constant during the last 10 years of the period with a slight upward tendency. This

indicates that under the systems of cropping practised in this experiment, the soil is not being depleted of nitrogen and organic matter, nor are the yields decreasing. Undoubtedly the legume crops have been a factor in maintaining the fertility of the soil. In general there is no definite indication that lime has tended to cause an abnormally rapid disappearance of nitrogen and organic matter from the soil. D. v. S.

546. Studies in Crop Variation and Response to Manures.

FISHER, R. A. and MACKENZIE, W. A. (Rothamsted Experimental Station, Harpenden). The manurial response of different potato varieties. *The Journal of Agricultural Science*, Vol. XIII, part 3, pp. 311-320, 2 diagr. Cambridge, 1923.

It is not infrequently assumed that varieties of cultivated plants differ not only in their suitability to different climatic and soil conditions, but in their response to different manures. Since the experimental error of field experiments is often under-estimated, this supposition affords a means of explaining discrepancies between the results of manurial experiments conducted with different varieties; in the absence of experimental evidence adequate to prove or disprove the supposed differences between varieties in their response to manures, such explanations cannot be definitely set aside, although one very often suspects that the discrepancies are in reality due to the normal errors in field experiments.

On the other hand, if important differences exist in the manurial response of varieties a great complication is introduced into both variety and manurial tests, and the practical application of the results of past tests becomes attended with considerable hazard. Only if such differences are non-existent, or quite unimportant, can variety tests conducted with a single manurial treatment give conclusive evidence as to the relative value of different varieties, or manurial tests conducted with a single variety give conclusive evidence as to the relative value of different manures.

In a recent experiment at Rothamsted twelve potato varieties were tested with six manurial treatments. The author gives in 5 tables the results of this experiment. The data show clearly, significant variation in yield due to variety, and to manurial treatment. There is no significant variation in response of different varieties to manure. D. v. S.

547. Manurial Experiments in Pots and in the Field.

MTSCHERLICH, E. A. Der Düngungsversuch (Gefäß- und Freiland-Versuch). *Landwirtschaftliche Jahrbücher*, Vol. LVIII, No. 1, pp. 125-158. Berlin, 1923.

Field experiment. — In the case of a field experiment the test plants are grown on the same soil, as the crop, cultivated later, but this advantage is counterbalanced by a large number of disadvantages.

In the first place, the experimental error is large on account of the physical and chemical differences in the soil. This difficulty can, however, be overcome to some extent by the use of small plots (25m²), by increasing the

number of the plots, and finally by adopting the method of equalising the results which has been described elsewhere by MITSCHERLICH.

Another trouble in field experiments is due to weed-infestation. This can be avoided by using only plants that are practicably free from weeds while the experimental error is diminished if a plant with a high yield per hectare, such as the potato, is employed. By the latter means, the author succeeded in reducing the experimental error to 1 or 2 % of the amounts obtained.

There still remains a third disadvantage in field experiments; in years of drought, or whenever owing to the influence of other factors, the fertiliser fails to produce any increase in the yield, no conclusions can be drawn from the results obtained.

Pot experiments — In pot cultures, the conditions due to water, temperature and nutritive substances can be improved to the extent of obtaining returns ten times higher than the yield from the open field. Pot experiments are quite independent of meteorological conditions and the soil used can be an average sample of that in which the plants will subsequently be cultivated. There are, notwithstanding, certain disadvantages as the soil used can, at most, be only a layer of 16 cm., as compared with the whole depth of soil found in the field, therefore no data can be obtained regarding the very variable quantities of nutrients substances present in the sub-soil.

Further, it is impossible to use plants like the potato that give a high return, as owing to the large surface area they occupy, the individual error would be too high. For his pot experiments, the author chose oats, since 35 individuals can be grown in one pot and the results can be expressed in quintals per hectare, like those obtained from field experiments with potatoes.

The differences in yield are, however, really larger in the case of pot cultures, hence the great importance of the latter in manurial experiments.

The author has already shown elsewhere (*Landwirtsch. Jahrbücher*, Vol. LVI, pp. 71-92) that the effective value of a factor influencing growth is constant, quite independently of other factors. The relation of the pot experiment and of the field experiment is theoretically determined. The effective value (*Wirkungswert*) of a fertiliser is always the same; that is to say, the increase of the crop in percentage of the maximum yield remains unvaried for the same quantities of fertiliser, whatever this maximum yield may be, or whatever other factors may come into play. Therefore, the fact that the conditions of water, temperature light etc., are good is of no importance.

It is, however, absolutely necessary for the effective value (*Wirkungswert*) to be expressed in relation to the same surface unit. This can be done by means of the equation:

$$\log (A - y) = \log. A - c x$$

The effective value c , is thus entirely independent of the maximum yield A , and of the yield y , but it is not independent of the amount of fertiliser applied, x .

The author made over 1000 pot experiments and as many field experiments in the course of this work (6 parallel experiments in pots and 4 in the field). The results obtained are given in 60 tables. He quotes the following as the axiom:

The effective value of sulphate of ammonium is 0.025 expressed in quintals per hectare. — This statement is proved by means of the above equation expressing y (the increased yield) in percentage of the maximum yield (A here = 100). The value x represents the amount of sulphate of ammonia applied, expressed in quintals per hectare $\log(100 = y) = 2 - 0.023 x$.

TABLE I.

Fertiliser x quintals per hectare	Yield y in %	Fertiliser x quintals per hectare	Yield y in %	Fertiliser x quintals per hectare	Yield y in %	Fertiliser x quintals per hectare	Yield y in %
0.0	0.0	7.0	33.2	14.0	55.3	27.0	78.9
0.5	2.8	7.5	35.1	14.5	56.6	28.0	80.1
1.0	5.6	8.0	36.9	15.0	57.8	29.0	81.2
1.5	8.3	8.5	38.7	16.0	60.2	30.0	82.2
2.0	10.9	9.0	40.4	17.0	62.4	32.0	84.1
2.5	13.4	9.0	42.1	18.0	64.5	34.0	85.9
3.0	15.9	10.0	43.8	19.0	66.5	36.0	87.4
3.5	18.3	10.5	45.4	20.0	68.4	38.0	88.8
4.0	20.6	11.0	46.9	21.0	70.2	40.0	90.0
4.5	22.8	11.5	48.4	22.0	71.8	45.0	92.5
5.0	25.0	12.0	49.9	23.0	73.4	50.0	94.4
5.5	27.1	12.5	51.3	24.0	74.9	60.0	96.8
6.0	29.2	13.0	52.7	25.0	76.3	75.0	98.7
6.5	31.2	13.5	54.0	26.0	77.6	100.0	99.7

Assuming that 20 quintals of sulphate of ammonia per hectare were found in the soil used for the pot experiments, the unfertilised pot would give 10.9 % of the maximum yield (see table). With 18.0 quintals of sulphate of ammonia per hectare, we should obtain 64.5 % of the maximum yield, or 492 % more than the yield of the unfertilised pot.

In the field, the layer upon which the plants can draw is twice as deep so that without a fertiliser we get 10 quintals of nitrogen per hectare and a return of 43.8 % of the maximum yield. By increasing the rate to 18.0 quintals per hectare in an attempt to get 64.5 % of the maximum yield, the increased yield would only be 20.7 % of the maximum yield, or 47 % of the yield already produced without any application of fertiliser.

The increase in the yield is thus about 10 times greater than in the case of the field experiments. This is what confers a great advantage upon the pot experiments which are able to register slight differences. A fertiliser producing no increase in yield in pot cultures would certainly fail to augment the crop in the field.

In the tables recording the results, the author always gives the value of y calculated according to the logarithmic equation alongside of the found

value of y . The agreement between the figures is so striking, that 0.025 can be accepted without reserve as being the value for sulphate of ammonia.

In a similar manner, the author determines the factor for nitrate of soda; the effective value of this fertiliser can be expressed by 0.02.

The experiments made for the purpose of determining the potash factor proved less interesting, because the soils used reacted but little on potash. The relation existing between the pot and the field experiments was, however, brought out very clearly.

The phosphoric acid experiments will be published separately.

The author also gives a comparative table.

TABLE II. — Effect of 100 kg. of fertiliser per hectare of surface on the yield expressed in % of maximum yield.

a = sulphate of ammonia

b = superphosphate

c = 40 % potash salts

Quintals per hectare	a	b	c	Quintals per hectare	a	b	c	Quintals per hectare	a	b	c
0.0	0.0	0.0	0.0	8.0	36.2	77.1	91.4	17	62.4	95.6	99.6
0.5	2.8	8.8	14.2	8.5	38.7	79.1	92.6	18	64.5	96.4	99.6
1.0	5.6	16.8	26.4	9.0	40.4	80.9	93.7	19	66.5	97.0	99.7
1.5	8.3	24.1	36.9	9.5	42.1	82.6	94.6	20	68.4	97.5	99.8
2.0	10.9	30.8	45.9	10.0	43.8	84.1	95.4	21	70.2	97.9	99.8
2.5	13.4	36.9	53.6	10.5	45.4	85.5	96.0	22	71.8	98.3	99.9
3.0	15.9	42.5	60.2	11.0	46.9	86.8	96.6	23	73.4	98.5	99.9
3.5	18.3	47.5	65.8	11.5	48.4	88.0	97.1	24	74.9	98.7	99.9
4.0	20.6	52.1	70.7	12.0	49.9	89.0	97.5	25	76.3	98.9	100.0
4.5	22.8	56.2	74.9	12.5	51.3	90.0	97.8	26	77.6	99.1	100.0
5.0	25.0	60.2	78.5	13.0	52.7	90.9	98.1	28	80.1	99.4	100.0
5.5	27.1	63.7	81.5	13.5	54.0	91.7	98.4	30	82.2	99.6	100.0
6.0	29.2	66.9	84.1	14.0	55.3	92.4	98.6	35	86.7	99.8	100.0
6.5	31.2	69.8	86.4	14.5	56.6	93.1	98.8	40	90.0	99.9	100.0
7.0	33.2	72.5	88.3	15.0	57.8	93.7	99.0	45	92.5	99.9	100.0
7.5	35.1	74.9	90.0	16.0	60.2	94.8	99.3	50	94.4	100.0	100.0

Before the war, the following was considered a liberal dressing:

3	quintals per hectare	sulphate of ammonia	(a)
5	"	"	superphosphate (b)
4	"	"	40 % potash salts (c)

If the soils were dressed with 5 quintals per hectare of these fertilisers, or their equivalents, the yields would be increased as follows:

Ammoniacal fertiliser: increase 25.0 to 36.2 % of the maximum return obtainable with ammonium; phosphatic fertiliser from 60.2 to 84.1 % increase; potash fertiliser: 78.5 to 93.7 % increase.

Thus, only one-third of the maximum yield produced by nitrogen can

be obtained, whereas with phosphoric acid, and especially with potash, the maximum yield is almost reached.

Assuming that the soil already contains 10 quintals per hectare of each of these fertilisers, this result is still more pronounced.

Increase due to nitrogen from	43.8 to 52.7 %
" " phosphoric acid, from.	85.5 " 93.7 %
" " potash, from.	95.4 " 98.6 %

It is, therefore, not surprising that most soils are very susceptible to a nitrogenous fertiliser, but it would be a great mistake to give up *a priori* the use of phosphoric acid and potash as fertilisers, for only small quantities of these substances may very considerably increase the crop (see table II). Superphosphate applied at the rate of 5 quintals per hectare may sometimes double the return. A heavy dressing with a nitrogenous fertiliser is to be recommended generally, where the upper layer of the soil contains less than 5 quintals per hectare of sulphate of ammonia. If there are already 20 quintals per hectare present in the soil, a nitrogenous fertiliser will have no further effect.

The author's work has thus shown the importance of pot experiments for the determination of the manurial requirements of different soils.

D. v. S.

548. Results of Experiments in Field-Manuring, made during 1918-19 in the Territory of the "Vorstenlandsche Tabakscultuur" (Java).

BEETS, A. N. J. Bemeestings proeven 1918-19. *Proefstation voor Vorstenlandsche Tabak*. Meedeeling, No. 46, pp. 1-66. Buitenzorg, 1923.

During 1918-19 the following manures were tried on the experiment fields: 1) Lime; 2) Dessa-earth; 3) Stable-manure; 4) Sulphate of ammonia; 5) Nitrate of soda, Phosphate-manure; 6) Bat-dung; 7) Earth-nut-cake; 9) Tobacco-seed cake. The field-experiment on the Djoewiring Estate showed clearly that on the heavy soil on which the test was made, where tobacco had never been planted, the manuring with lime had a favourable influence both on the yield per acre and on the length, quality and colour of the leaves.

Manuring with dessa-earth and stable-manure gave the same good results as in past years (see Publications 32 and 41). These manures deserve the fullest attention on different sorts of soil by reason of: 1) the yield per acre; 2) the length of the leaves; 3) the quality of the product, but they can, under certain circumstances, lead to infection of the soil with *Phytophthora Nicotianae*, the cause of the well-known "lanas" disease.

The effect of manuring the plants with sulphate of ammonia was nearly everywhere well shown by measuring the length of the leaves. The conditions were not favourable in this year. The plants on the different test-gardens were nearly full grown when it began raining, in consequence of which the leaves from the lower part of the plants could not benefit from the manure. By measuring the length of the leaves from

the middle and upper-part of the plants, the advantage from the manure was shown in nearly every instance.

Nitrate of soda, a very hygroscopic salt, gave a less good result than sulphate of ammonia, notwithstanding the fact that the same quantity of nitrogen was given to the plants.

Phosphates gave no certain result, owing to the miscarriage of many test-fields, caused by diseases among the young plants.

Bat-dung (collected in caves as a product of the excrements of bats) gave nowhere good results.

Earthnut cake (katjang-boengkil), a by-product of the manufacture of oil from seeds of *Arachis hypogea*, had a very good effect on the growth of the plants on a grey heavy soil, which was shown by the yield per plant and by measuring the length of the leaves.

Tobacco-seed cake (tabakszaad boengkil) gave good results but it will not be possible to get enough of this manure for manurial purposes on a whole estate, as it is necessary to give a large amount per plant (7 % nitrogen). In some of the field tests it was shown that it is necessary to mix the seed cake manures very well with the soil before planting. If this is not done, many of the plants die shortly after planting.

D. v. S.

549. The Maintenance of Organic Matter in Soils.

SIEVERS, F. J. (Washington Agricultural Experiment Station). *Science*, vol. LVIII, No. 1492, pp. 78-79. Lancaster, Pa, 1923.

Investigations have shown that the ratio between the nitrogen and the organic matter, and also between the carbon and the organic matters of soils, is practically a constant, e. g. —

$$\begin{aligned} \text{Organic matter} &= \text{Carbon} \times 1.724 \\ \text{or Organic matter} &= \text{Carbon dioxide} \times 0.471 \\ \text{or Organic matter} &= \text{Nitrogen} \times 20 \\ \text{then } \frac{\text{Carbon}}{\text{Nitrogen}} &= \frac{20}{1.724} \end{aligned}$$

or Nitrogen : Carbon :: 1 : 11.6.

When organic matter composed of low nitrogen carrying material, is applied to a soil, nitrate accumulation is hindered, and this effect continues until decomposition liberates sufficient carbon, in the form of CO_2 , to restore the nitrogen carbon ratio to about 1 : 12. Under natural conditions this ratio is maintained, but in the case of intensive cultivation the carbon is lost more rapidly, than the nitrogen, and the ratio is always slightly narrower in cropped than in virgin soil.

Manure contains only about 10 lb. of nitrogen to the ton, and straw contains a similar amount, hence this quantity of nitrogen can fix only about 120 lb. carbon, or a total of 200 lb. of organic matter, which when decomposed would not supply the requirements of one crop.

To maintain soil organic matter the nitrogen supply must be maintained, in which case sufficient carbon will be fixed. This can be done

through the growth of legumes and the use of fertilisers. The ill effects of legumes or straw used singly can be avoided by adding the straw as a surface dressing on the legume soil before it is broken up by the plough.

W. S. G.

550. Phosphate Reserves of Russia.

PRJANISCHNIKOW. Phosphoritlager im Russland in Lichte der neueren Forschungen. *Zeitschrift für Pflanzenernährung und Düngung*, Vol. II, No. 6, pp. 315-321. Leipzig-Berlin, 1923.

The phosphate question occupies as prominent a position in the fertiliser problem in Russia as it does in Germany in spite of the different development of the rural economy of the two countries.

Germany, notwithstanding her intensive cultivation, has been able by means of her chemical industry to obtain all the potash and nitrogen she needs, but since she possesses few, or no, deposits of natural phosphorite, she has great difficulty in satisfying her phosphate requirements.

Russia, on the other hand, has hitherto been a country of extensive cultivation, and consequently of low yields. In exporting countries where wheat is cheap, the crop returns are always less than in importing countries. The fertilisers commonly applied in Western Europe could not be used in Russia on account of their prohibitive price; in the wheat-growing provinces, nitrate, for instance, costs $3\frac{1}{2}$ to 4 times as much as barley. The high price of fertilisers, and not the Russian peasants' lack of technical knowledge, has prevented their application to the land. Further, the soils of Southern Russia (Black Soils), are so rich in nitrogen, that leaving the fields fallow produces an accumulation of nitrates. The soils of Northern Russia need fertilisers, but the sole manure generally available is dung, or clover; only in the case of sugar beets, or kitchen-garden crops, could nitrate be afforded. The same may be said of potassic fertilisers, although Russia possesses a supply of potash in the form of ashes (annual production 1.5 million tons).

The question of phosphates is quite different, nearly all the Russian soils including the black soils, react to a phosphatic fertiliser, and even before the war, more or less phosphates were applied.

Now, however, the conditions have entirely changed, for as super-production has ceased in the South, the northern areas are forced to produce their own wheat, and since dung is lacking, the only course is to use mineral fertilisers, and especially phosphates. Russia possesses extensive deposits of phosphorite that could be worked, and even exported, if means of transport were established. The whole question has been studied lately and the findings of the Commission appointed to investigate these deposits have been published in two series by the Moscow Academy of Agriculture (PETROWOKO-RASUMOWSKÉ) under the titles of, I. Geological Researches on Russian Phosphorites; II. The Chemical Treatment of Russian Phosphorites and Researches on their Application (published in 1919 and 1921).

The preliminary investigations have shown the existence of 5568 million tons of phosphorite which is, however, of very varying quality.

Type 1	(containing over 24 % P_2O_5)	141 million tons
2	(" 18 — 24 % P_2O_5)	1707 " "
3	(" 12 — 18 % P_2O_5)	3730 " "
		5568

Considerable deposits of phosphorites belonging to the first type are believed to be present, although they have not yet been surveyed. The author gives a description of the phosphorite deposits basing his observations on the data supplied by Prof. SAMOILOW. The most important are those on the banks of the Kama, in the Government of Wjatka. Similar phosphorites much resembling the phosphates of South Carolina are to be found on the banks of the Volga near the town of Kineschma (present output about 3000 tons per annum).

The author also describes the deposits in the Governments of: Moscow and Kaluga (21 to 24 % P_2O_5); Simbirsk, Penda and Tambow (20 to 21 %); Tschernigow (23 %). A single continuous deposit extends across the Governments of Smolensk, Kaluga, Orel, Kurrsk and Woronesch (15 % P_2O_5). Similar phosphorites are also to be found on the peninsula of Mangyschlak. In the Urals, phosphorite deposits with 32 to 36 % P_2O_5 have been discovered, while in Bessarabia, there are beds with 32 to 35 % P_2O_5 , but their extent has not yet been ascertained.

The large Ural reserves could well be used for making superphosphate and the phosphorite found on the banks of the Kama might be transported as far as the Volga, if the bed of the Kama was deepened for a distance of some 200 km., and may therefore be reckoned among the phosphates that can be exported to Germany.

The phosphorites with a low percentage of P_2O_5 can be used in two ways:

1) Transformed into a 40 % double superphosphate, or precipitated phosphate;

2) Applied in a pulverised form without any chemical treatment.

The author has studied the extraction of these phosphorites by treatment with sulphuric acid in the laboratory, and is of opinion that the precipitated phosphate process is likely to be the one most adopted in future.

Pulverised phosphorite is to be recommended in the case of certain plants 1) and soils 2) and for use in conjunction with some other fertilisers 3).

1) Application of phosphorite to lupins to be used as green manure (see articles of the same author in 1896-7).

2) Certain acid soils but also some soils that are not saturated with bases, have the power of decomposing phosphorites. This type of soil is very common around the black soils. Prof. KNIERIM (Riga) states that phosphorites mixed with peat (1:100) form a good fertiliser with $\frac{2}{3}$ of the phosphoric acid in a soluble condition.

3) Sulphate of ammonium mixed with phosphorite increases the solubility of the latter (see articles of the same author, 1900)

The author is of opinion that the phosphorite deposits of Russia will soon become of considerable importance.

D. v. S.

[556]

551. The Constitution and Manurial Value of Low Grade Basic Slag.

MCARTHUR, D. N. *Journal of the Society of Chemical Industry*, Vol. XLII, No. 20, pp. 213-216, bibliography, London 1923.

The basic process for the manufacture of steel has recently undergone many changes, and the basic open-hearth fluor-spar slags are not comparable in fertilising value with the Bessemer slags, and the citric-solubility test is merely empirical in estimating their value.

The author made a great number of chemical and microscopical examinations of open-hearth slags, and carried out pot and field trials to ascertain the relation between their constitution and the manurial value.

The conclusions drawn from the experiments were that, open-hearth fluor-spar slags of low phosphate content have a distinct fertilising value and could be used to replace ground limestone in agricultural practice. The experiments showed clearly the importance of fineness of grinding on the availability of slags.

W. S. G.

552. The Nitrogen Problem in Great Britain.

KILBURN SCOTT, E. Nitrogen Fixation by the Arc process. *The Chemical Trade Journal and Chemical Engineer*, Vol. LXXII, No. 1875, pp. 451-453. London, 1923. — IDEM. Progress in Nitrogen Fixation. *Ibidem*, Vol. LXXII, No. 1874, p. 488. London, 1923. — IDEM. The Muscle-Sheals Nitrogen-fixation plant. *Ibidem* Vol. LXXII, No. 1875, pp. 513-514. London, 1923. IDEM Nitrogen, Fixation problems. *Ibidem*, Vol. LXXII, No. 1875, pp. 515-516, London, 1923. — *Ibidem*, Nitrates from the air. *Chemistry and Industry*, Vol. 42, No. 20, pp. 498-499. London, 1923.

During April 1923 Mr. KILBURN SCOTT gave a series of three Cantor Lectures at the Royal Society of Arts (London) on the fixation of nitrogen from the air. He appears to be an enthusiastic advocate of the development in Great Britain of direct electrical processes for the manufacture of nitrates and he has himself invented a nitrogen furnace using three phase current.

In the first of his lectures he mentioned the reasons which led the Ministry of Munitions to install a small cyanamide factory at Dagenham Dock and ultimately to erect a large factory for the manufacture of ammonia by the Haber process at Billingham-en-Tees. One method which would have produced nitric acid with absolute certainty with the least possible amount of labour and no cost for raw materials, is the arc process, but this was deliberately shelved by the men at the head of affairs.

Coming to the technical part of the subject he, divided the methods of making nitrates from the air electrically into two parts; the direct and the indirect methods, the first being a single process and mainly electrical, the second consisting of several processes partly chemical and partly electrical. The several types of nitrogen fixation arc furnaces are divided into groups according to the methods of forming the arc flames:

1) Those which have a mechanically moving part—viz., the Bradley and Lovejoy (Niagara Falls) and the Island (Toronto).

2) Those which have a magnetic field to direct the arcs—viz., the Birkeland-Eyde (Norway and France) and the Moscicki (Switzerland),

3) Those which have a rodlike standing arc—viz., the Schonherr (Norway) and the Wiegolofsky (Seattle, U. S. A.).

4) Those which depend upon air currents to direct the arc—viz., Pauling (Innsbruck) and the Hocklenbleckner (Nitroles S. X., U. S. A.). All the above require single phase alternating current, and have to be used in sets of three, on the three phase circuit.

5) The Kilburn Scott furnace, which has air-blow arc flames and pilot arcs to keep them steady (Birmingham and New Jersey, U. S. A.).

6) The Nitrum furnace (Bodio, Switzerland, and Rhina, Germany). This has a disc-like arc revolved horizontally by three air currents. Systems 5 and 6 use three phase current in one reaction chamber.

The usual production from a single phase type of furnace, employed in Norway, amounts to 62 gm. of nitric acid per kw.-hr., whilst tests on the three phase type of furnace have given between 90 and 100 gm. of nitric acid per kw. hr. The commercial importance of the arc process is illustrated by figures of the output of the Norsk Hydro-Elektrisk Kvaestefakselskab which supplied during 1919, 67 419 tons of nitrate of lime and exported about 50 000 tons of nitric acid, sodium nitrite, sodium nitrate and ammonium nitrate.

A description is given of the plant at Pierrefitte (Pyrenées) which uses also Birkeland Eyde furnaces and where nitric acid can be manufactured at a cost of £6 per ton, power costing 20 s. per kw.-year.

As illustrating the three-phase system the furnaces used by the Nitrum Co. of Zurich (Switzerland) are taken. The yield of nitric acid is from 75 to 80 gm. per kw.-hr. The Nitrum process has given good results in a 6000 kw. plant at Bodio, Switzerland, for over 10 years and at Rhina, near Laufenburg for 7 years.

In an arc process plant the percentage of capital cost of the acid and alkali absorption towers is nearly half the total cost, and the problem to be solved is to cut down this great capital expenditure. It can be reduced by increasing the percentage of nitric acid, as in the Nitrum furnace, which results in a reduction of the tower size.

Another method would be to pass the gases through the towers under pressure as adopted in the latest type of Häusser plant. The improvements in the Häusser plant (Westphalia) consist in increasing the capacities of the bombs used.

A description is given of the American Mussel Shoals plant, which was only tested and had been standing ever since. It was intended to produce 40 000 tons of fixed nitrogen per annum. In this plant nitrogen is fixed as cyanamide; ammonia is produced from cyanamide and ammonia converted into nitrogen oxides.

In his third and last lecture Mr. SCOTT describes the Haber and the Claude processes, both synthetic ammonia processes. It would seem that the huge scale upon which Germany is exploiting the Haber process has consciously or unconsciously influenced the minds of the vast majority of technologists in England and France into the belief that the Haber process

is the one to be adopted wherever possible, and that the arc process is only to be considered seriously in very exceptional cases. *The Water Power Resources Committee* of the Board of trade, who investigated the subject in 1922, estimated that the potential resources of water power in Great Britain are capable of producing some 250 000 H. P. of which 160 000 are available in Scotland.

The lecturer pointed out that New Zealand wanted fertilisers and that in that country there are many waterfalls, so that it is an ideal country for the making of fertilisers by the arc process. In India there are waterfalls, and also coal mines and the arc process could be used near the former and the Häusser process near the latter. He agreed that it was economically unsound to utilise ammonia for making nitric acid when the latter could be obtained in other ways. Finally he pleaded for a *Nitrogen Research Department*.

D. v. S.

553. The Efficient Recovery of Nitrates from Caliche.

TURRENTINE, J. W. (Bureau of Soils, U. S. Department of Agriculture). *Industrial and Engineering Chemistry*, Vol. 15, No. 8, pp. 853-855. Washington, 1923.

The many reports appearing in the current press relative to the present situation in the nitrate industry of Chile all give substance to the impression that conditions there are far from ideal. The situation is confused with various elements, such as local politics, finance and international commerce, but evidence remains that the trouble is fundamentally one of poor chemical engineering. The nitrate industry is experiencing the results of the total loss of an important part of its market, Germany, now on an entirely self-supporting basis. It is faced with the loss of other markets through a similar development of the air nitrate industry in the various countries, notably the United States. It is evident that the perpetuation of the Chilean industry is not essential to America, but it is not certain that its destruction will not prove a great loss to the world in general.

The cost of producing and selling Chile nitrate has been apportioned as follows:

Export tax	41
Bags	6
Transportation	11
Overhead Tax	3
Labor	19
Fuel	11
Interest	9

Great improvement in the situation could be made in three directions. The Government might surrender its export tax, thus reducing the price in the market by that substantial amount. Plants and processes could be improved so as to reduce the manufacturing costs. If capital is not readily available, it could be furnished by the Government with the enforced amalgamation of small properties into larger groups, thus greatly reducing

the cost of rehabilitation. (The prosperity of the Chilean government is so intimately linked with that of the industry that the two cannot be separated). With new processes the yield from by products, now imperfectly exploited could be increased. Propagandizing activities in foreign countries could be enlarged.

D. v. S.

554. The Application of Nitrogenous Fertilisers to Grassland.

HOFFMANN, R. Stickstoff-Düngungsversuche auf Grünland. *Landwirtschaftliche Jahrbücher*, Vol. LVIII, No. 4, pp. 567-600. Berlin, 1923.

As a result of his experiments, WAGNER concluded that a nitrogenous fertiliser was not to be recommended for meadows. (WAGNER: "Versuche über Wiesendüngung", *Arbeiten der D. L. G.*, No 162, and also "Die Düngung der Wiesen" *Arbeiten der D. L. G.* No. 308). Other investigators, such as WARNBOLDT (*Jahrbuch der D. L. G.*, 1918), and NEUBAUER (*Mitteilungen der D. L. G.*, No. 50, No. 108, 1921) do not agree with his dictum, and strongly advocate the application of nitrogenous fertilisers to grass-land.

This divergence of opinions is probably due to differences in the soils used in their experiments by the several workers.

The author based his research upon the experimental methods practised by MITSCHERLICH; these allow results to be interpreted in a strictly mathematical and wholly objective manner. His conclusions may be summarised as follows:

The hay yields (in quintals per hectare), may be expressed, in logarithmic function of the amount of sulphate (quintals per hectare) applied, by the following equation: $\log. (A - y) = \log. A - 0.025 (x + z)$.

In this equation, A represents the maximum yield, y the quintals of hay per hectare, and x the quintals of sulphate of ammonia per hectare. By means of this formula, it is possible to calculate in advance the hay yield obtainable with any given amount of sulphate of ammonia (provided A be known).

The effective value of the ammonium sulphate expressed in the formula by the factor $c = 0.025$ proved constant in all the experiments, that is to say, it is independent of all the factors affecting A . Therefore, a determined value in relation to the other nitrogenous fertilisers may be given to ammonium sulphate. This value is 0.025 and is independent of climate, soil, the species of plant cultivated, etc.

In the equation, the value z expresses, in quintals per hectare, the amount of nitrogen equivalent to the sulphate of ammonia contained in the soil. The author made experiments with 3 types of grass-land:

I Meadows of timothy-grass (<i>Phleum pratense</i>) 3 =	}	14.86
		12.84
II Permanent pastures 3 =	}	4.45
		4.19
		3.00
III Meadow-moors (Moor-Wiesen) 3 =		9.00

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The great effect made upon grassland with a mineral sub-soil is thus easily explained. A potassic phosphatic fertiliser has generally no effect; only in one case did the author record a higher yield due to its application.

The nitrogenous fertiliser considerably increased the growth of grass, even in plots I, but the clover entirely disappeared. In plots II, there was an increase in the number of dandelions (*Taraxacum officinale*) and of yarrow (*Achillea millefolium*), especially in the second cutting. The latter only gave a better return when at least 8 quintals of sulphate of ammonia were applied per hectare.

The author detected a slight toxic action upon the plants when the field had been dressed with 8 quintals of ammonium sulphate + 2 quintals of 40% potash salts + 3 quintals superphosphate per hectare.

The differences due to soil variation can be reduced by one half if the MITSCHERLICH method of calculation is adopted. D. v. S.

555. Efficiency of Ammonium Sulphate on Alkaline Soil.

PRESCOTT, J. A. (Sultanic Agricultural Society, Cairo, Egypt). The efficiency of ammonium sulphate as a fertiliser. *The Journal of Agricultural Science*, Vol. XIII, No. 3, pp. 331-339, 1 fig. Cambridge, 1923.

Field experiments with maize at the Bahtim Experimental Station and laboratory tests indicate that the lower efficiency of ammonium sulphate as compared with nitrate of soda is due, principally under these special conditions, to the liberation of ammonia from the fertiliser in contact with an alkaline soil. The rate of this liberation is a function of the aeration and of the soil reaction. D. v. S.

Agricultural Botany.

556. Electrically-Induced Changes in Plants.

I. — RAGIONIERI, A., and MEUNISSIER, A. L'électro génétique. *Revue Horticole*, Year 95, No. 16, p. 334. Paris, 1923.

II. — PIROVANO, A., Sur la Discipline de l'hérédité chez les végétaux : l'électrogénétique. *Ibidem*, No. 21, pp. 459-463, figs. 9.

I and II. — It is to PIROVANO we owe the ingenious idea of producing changes in different species of plants by the modification of the genital plasma previous to fertilisation, for which purpose he used electricity (1). This electricity is derived from various sources: electromagnetism, x-rays, ultra-violet rays, and radio-active emanations. PIROVANO worked upon pollen (male reproductive plasma), as being easily handled, and obtained most remarkable results. The pumpkin (*Cucurbita Pepo* var. *cucurbitella*), which is habitually a dioecious plant, was rendered monoecious, and even hermaphrodite; the wild *Althaea rosea* underwent changes in habit, and also in the size, colour shape and arrangement of the flowers, so that

(1) See: ALBERTO PIROVANO, *La mutazione elettrica delle specie botaniche e la disciplina dell'eredità nell'ibridazione*. Milan, Hoepli, 1923.

they assumed the appearance of the flowers belonging to *Hibiscus Syriacus*. In other species, gigantism, dwarfness, a tendency to run to seed, changes in the shape of the fruits etc. were produced. These changes have proved to be transmissible.

PIROVANO has applied the term ionolozation ("ionolizzazione") to this process of altering pollen by means of electricity which disturbs the molecules of the genital plasm so as to prevent its reproducing the species in the natural way, although the fertilising property of the pollen is not impaired.

When ionolization is produced by alternate currents, results of considerable importance are only obtained with short exposures to high frequency currents (500 or 600 periods), but even with the ordinary electric-light plant used for an electro-magnet, it is possible to carry out the simple experiments described and explained by the author. Any horticulturist can thus obtain varied and strange forms.

F. D.

557. Iron and Manganese Content of certain Species of Seeds.

MCHARGUE, J. S. *Journal of Agricultural Research*, Vol. XXIII, No. 6, pp. 395-399. Washington, D. C., 1923.

In recognition of the fact that manganese is a necessary nutrient in plant growth, the author made a series of determinations as to the amount of iron and manganese contained in seeds of certain species of plants and has correlated the results obtained. The species tested included: wheat, oats, peas, beans, soy beans, clovers, grasses, sunflower, hemp, flax, rape, tobacco.

Results indicate that the average manganese content of seeds of wheat and oats produced under normal conditions in the soil is equal to the average iron content. The oatmeal prepared for human consumption affords one of the richest sources of manganese in food.

In the seeds of leguminous plants, the proportion of manganese is invariably less than the iron content. For garden peas and beans the average rate is 1:6; for soy beans 1:3; for clover 1:4; for *Agrostis* spp. 1:3. The manganese content of wheat and oats is approximately three times that contained in peas and beans.

The amount of iron and manganese found in grasses showed considerable fluctuations with varieties, but the average results are nearly equal. White and yellow maize contained the smallest amount of both. Hemp on the contrary showed a comparatively high percentage.

M. L. Y.

558. Effect of Manganese on Plant Growth.

I. MCHARGUE, J. S. (Department of Chemistry, Kentucky Agricultural Experiment Station). *The Role of Manganese in Plants. The Journal of the American Chemical Society*, Vol. 44, No. 7, pp. 1592-1598, figs. 2, Easton Pa., 1922.

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II. IDEM. Effect of Manganese on Plant Growth, *Journal of Agricultural Research*, Vol. XXIV, No. 9, pp. 781-794, tables 6, bibliography. Washington, D. C., 1923.

Reference is made to foregoing investigations on this subject (1). The purpose of the author in continuing these studies was two-fold:— To determine definitely if manganese is an essential element in plant economy, and to show the effect of increased concentrations of manganese sulphate on plant growth.

Earlier experiments have shown that the seed coat contains a greater concentration of manganese than any other part of the seed, and working on this basis the author carried out tests to ascertain the ultimate effect on plant growth if seeds are germinated and the plants grown to maturity in a medium which contained all the known plant nutrients with the exception of manganese compounds. Results indicate that in a *limited* degree, manganese is evidently essential for normal growth and development of plants. The first effect to be noted is the lack of formation of chlorophyll and the obvious function of manganese in the photosynthetic process. The subsequent etiolated condition of the leaves and buds bears out this point. Apparently leguminous plants are dependent on this factor more than non-legumes. Seeds of plants tested (radish, soy bean, cowpea, field pea) maintained normal development only for the first 4-6 weeks of growth, suggesting that manganese is concerned in nitrogen assimilation and syntheses of protein.

As regards the possible deleterious effect of *excess* of manganese on growth, experiments were made at the Kentucky Agricultural Experiment Station with plants grown in acid and neutralised portions of the same soil to which were added definite amounts of manganese sulphate. Results demonstrated that an excess of manganese sulphate in acid soils has a detrimental effect on plant growth. Applications have caused a distinct decrease in crop yield. The addition of calcium carbonate has, however, a neutralising effect and has resulted in a subsequent increase in yield of similar crops.

It should be noted that manganese is intimately associated with iron, phosphorus and calcium compounds, and bearing in mind the fact that only very small amounts of this element are required for plant nutriment, it is probable that contamination of the nutrients with manganese has hitherto been an unrecognised source of error in determining the requirements of plant economy.

Further investigations are in progress, with a view to ascertaining the relation of manganese to other important phases of plant and animal life.

M. L. Y.

(1) Special attention should be drawn to the comprehensive work of Dr. W. BRENCLEY (Rothamsted Experimental Station) "Inorganic Plant Poisons and Stimulants", Cambridge, 1914. (Ed.)

559. **The Effect of Respiration upon the Protein Percentage of Wheat, Oats and Barley.**

Mc GINNIS, F. W. (Professor of Farm Crops, Division of Agronomy and Farm Management), and TAYLOR, G. S. (Division of Chemistry Department of Agriculture University of Minnesota) *Journal of Agricultural Research*, vol. XXIV, No. 12, pp. 1041-1048, tables 2, bibliography. Washington, D. C. 1923.

Investigations made at the Minnesota Agricultural Experiment Station based on the variation in protein percentage found in the different grains when produced under different conditions of soil and climate. Marquis wheat, improved Ligowa Oats and Manchuria barley were grown in 17 localities in the United States and respiration studies were made with the seeds each year.

The loss of carbohydrate material during the ripening process is apparently considerable. The greater percentage of loss incurred before the process of desiccation begins, while the grain contains above 40 % moisture. The protein content is influenced to a marked degree by the loss of carbohydrate during the ripening period. Environmental conditions have a marked influence on the synthetic process, and respiration plays a comparatively unimportant part. Wheat showed more variation in the protein percentage than barley or oats, and barley was apparently more variable than oats.

M. L. V.

560. **Relation between the Amount of Nutritive Substances in the Soil and their Assimilation by Plants.**

KÖNIG, HASENBAUMER and SCHAFERS. Beziehungen zwischen dem Nährstoffgehalt des Bodens und die Kartoffeln.

IDEM. Beziehungen zwischen dem Nährstoffgehalt des Bodens und der Nährstoffaufnahme durch den Hafer nebst einem Beitrag über den Einfluss von Pflanzen und Düngern auf die Bodensäure. *Landwirtschaftliche Jahrbücher*, Vol. LVIII, No. 1 pp. 55-124. Berlin, 1923.

Experiments with potatoes. — These experiments had for their object the determination of the relation between the quantity of easily soluble nutritive substances present in the soil and the amount of these substances actually assimilated by the plants.

The following methods were followed to estimate the quantities or the food substances that could be readily assimilated. I. — Extraction by steam (500 gm. of soil being treated for 5 hours with 4 litres of water under a pressure of 5 atmospheres). II. — Extraction with a 1 % solution of citric acid. The results obtained by the two methods are clearly too high if they are compared with the amounts actually assimilated by the plants. From 6 soils analysed, only 19.09 % to 61.80 % of the potash content (as determined by extraction with water-vapour), and 12.62 to 24.91 % (as determined by method II), was used by the potato. The values for phosphoric acid were still lower.

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The author considers this result was due to the unusual dryness of the season.

The ratio, potash: nitrogen: phosphoric acid in the case of the potato can also be used for estimating the fertiliser requirements of the soil. This ratio should be determined from an average crop. The author gives the following figures as normal, 100:70:25. Thus, for every 1000 gm. of the dry matter harvested, the values ought to be: potash 25 gm., nitrogen 18 gm. and phosphoric acid 6 gm. A much higher, or lower, ratio for any of these three nutritive substances indicates an excess, or a lack, of it in the soil.

The author is of opinion that by means of steam extraction, or the 1 % citric acid method, accurate data as to the manurial needs of soils can be obtained.

Experiments with oats. — The experiments made with oats showed the author that the amount of potash removed by these plants from the soil can be estimated more or less correctly by adopting the steam-extraction method, as he obtained concordant values by this means.

The amount of phosphoric acid absorbed was lower than that extracted by steam; the plants only assimilated 14 % to 15 % of this quantity.

When the phosphoric acid was extracted with 1 % citric acid, it was found that the plants absorbed 20 % of the quantity found in the soil.

These experiments were also carried out in order to calculate in advance the manurial requirements of the soil.

D. v. S.

561. Contribution to the Study of Variability in the Schizomycetes.

ROSSI, G. *Annali della R. Scuola Superiore di Agricoltura in Portici*, Vol. XVIII, 1923. Portici, Delle Torre.

The author states that studies of variability in the Schizomycetes are multiplying and that while, on the one hand, there is a tendency to believe with Gino DE ROSSI that experimental proof is lacking of the formation of new bacterial species, or varieties, or of the transformation of one species into another as a result of mutation, there is no doubt that the Schizomycetes have a considerable propensity to modify their morphological, and especially their physiological, characters under the influence of external stimuli, so as to produce new varieties. Some observers go so far as to believe with LOHNIS, HANZAWA and SMITH, in the passage of one species to another, and even in polymorphism which needs for its support a theory of bacterial morphology totally at variance with our present views. This is based on the existence of new reproductive organs in bacteria (gonidia), or rather, a different interpretation of already-observed morphological characters, as well as the formation of a *symplasm*, *corpi rigeneratori*, zygospores and a whole series of conceptions which would overthrow the classical bacteriology of Louis PASTEUR and Robert KOCH and lead us back to some extent to the views held by NÄGELI and DE BARY.

The author has observed in a line of *B. bulgaricum*, a cyclic and periodic variation arising in days, months or years and affecting not only the

form of the micro-organism, but also the character of the colony. To enter more into detail:

1) The *B. bulgaricum* used by the author was totally different according to whether it was cultivated on solid, or liquid media; in the first case, it assumed a short, thick shape 2-3 μ in length and 0.2-0.3 μ thick, while in the second, it inclined to an elongated shape and was at least 4-5 μ in length.

2) The passage from one form to the other is effected slowly if the bacterium passes from a solid medium to a liquid one, and in 20 days at least, during 4-5 passages, from one liquid medium to another.

3) When cultivated in liquid media, the shape of the bacterium varied from short to very long, 40-50 μ , but in all cultures, the short and very short forms occurred while the very long forms made their appearance at certain periods which, however, could not be precisely defined.

4) On solid media (potato, agar), the colour of the colonies was at times yellow and at others white, not alternately, or suddenly, but according to periods that might last for years. Intermediate forms were not lacking.

5) In liquid media, the forms called by most scientists involution forms were observed (these were respectively like a blister, or club-shaped, either thick or curved) which were easily identified with the zygospores, gonidia, and corpi rigeneratori of LÖHNIS.

The author proved that the latter can no longer be regarded as degenerate forms, since they occur when the culture is in the best and most normal conditions of existence, but their presence is very variable, since many years may pass without their making their appearance, whereas at other times, they are extremely numerous. For this reason, it is considered that even according to the new theory advanced by LÖHNIS, their signification is still far from being explained.

G. R.

Plant Breeding.

562. Some Effects of Physiological Conditions on Genetic Characters of Wheat.

GERICKE, W. F., *American Journal of Botany*, Vol. X, No. 6, pp. 275-Lancaster, Pa., 1923.

The relative earliness or lateness of maturation of wheat, and the awned or awnless form of the spikelets are two classes of genetic characters used by agriculturists to distinguish individual varieties. Under normal conditions of field culture these characters are fairly fixed in pure line strains. They change, however, with conditions of nutrition and external environment and this has been proved by the recent investigations here reported.

On December 15, 9 different varieties of spring wheat, representing a range from early to late types, were sown and kept under greenhouse conditions; these matured normally, the earliest in the last week of April and the latest 7 weeks after.

On March 20, another series of cultures under glass was made, but using tap water as the growth medium, which is very deficient in salt nutrients. To each culture at the beginning of the experiment was added a minute quantity of ferrous sulphate. All the varieties matured and produced grain, naturally only to a limited extent. The earliest variety matured during the last week of June, and the last during the first week of August. The order of maturity varied according to the soil and medium: for example, the variety "Bunyip" passed from the earliest (grown in soil) to the 5th earliest (using tap water). It is interesting to compare the changes occurring with other varieties hitherto considered to be mutant.

G. A.

563. Research on a Speltoid Mutation of Wheat

LINDHARD F. Fortgesetzt. Untersuchungen über Speltoidmutationen. *Hereditas*, Vol. IV, Parts 1-2, pp. 206-220. Lund, 1923.

Amongst the offspring of the normal type (Squarehead) of wheat heterozygous speltoid mutants make their appearance; these may give rise by successive mutation to heterozygous forms of *Compactum* which may in their turn, produce heterozygous Squarehead types. It was possible by means of a series of crosses between these mutants to establish the following structural formulae: $N \times H$ = normal type; $Sp \times H$ = heterozygous speltoid type Sp . $C \times N$ = heterozygous *Compactum* and $Sp \times SpC$ = heterozygous Squarehead.

The three last heterozygous types form a species of triangle that can only be explained by the theory of multiple allelomorphs, inasmuch as a cross between any two of these types can produce the heterozygous form of the third. The preliminary researches made by WINGE on the histology of these mutants would lead us to suppose that the heterozygous Squarehead Sp . Sp . C , and the heterozygous *Compactum* Sp . CN possess 41, instead of 42, chromosomes. The gamete *Compactum* Sp . C would appear to have 20, instead of 21, chromosomes, in other words, it is nothing but a speltoid gamete minus a certain chromosome. If this hypothesis was confirmed, the question of the relations between the different forms would to some extent be solved.

On crossing a mutant, heterozygous type of *Compactum* with the normal, awned form ($USpC \times uN$), the resulting hybrid should have eight $USpC$ gametes to every one $USpC$ gamete, while the hybrid $SpC \times uN$ ought to produce 8 $uSpC$: 1 $USpC$ which is what actually occurs.

This correlation between the factor U and the absence of one chromosome (an absence which produces the *Compactum* form), could be explained by supposing that some chromosomes do not separate according to the law of probability, but tend to more *en masse* towards one or other pole.

G. A.

564. **Length of Rachis Internodes and Number of Spikelets in the Progeny of Speltoid and Heterozygous Forms of Wheat.**

KAJANUS BIRGER. Über Ährchenabstand und Ährchenzahl bei Nachkommenschaften von Speltoidi-Heterozygoten. *Hereditas*, Vol. IV, Parts 1-2, pp. 10-16. Lund, 1923.

This paper gives the results obtained from some researches on the length of the internodes of the rachis and the number of spikelets in the progeny of speltoid and heterozygous forms of wheat. The increase in the length of the internodes and the smaller number of spikelets in the series *Vulgare* — heterozygous — speltoid is clearly seen in the F_2 of *vulgare* \times speltoid, in which the heterozygotes present intermediate conditions. From a summary of the data referring to the length of the internodes (distance in millimeters between the insertion of the spikelets) the plants may be divided into 11 classes according to internode lengths ranging from 3.1-3.5 to 8.1-8.5.

	3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1-7.5	7.6-8.0	8.1-8.5	Sum	Average
<i>Vulgare</i>	2	23	48	28	2	—	—	—	—	—	—	103	4.32
Heterozygous	—	—	17	76	93	40	8	1	1	—	—	236	5.20
Speltoid	—	—	2	4	22	53	40	8	1	1	1	132	5.95

As regards number of spikelets, there is an average of 21.63 for *Vulgare*; 20.75 for the heterozygotes and 20.04 for the speltoids.

G. A.

565. **Banats Wheat.**

NIKOLIČ, M. Banatska pšenica. *Zeitschrift für Pflanzenzüchtung*, Vol. IX, Part 1, p. 71. Berlin, March 1923.

Banats wheat (Banater Weizen) belongs to *Triticum vulgare aristatum*, var. *erythrospermum*. The ears are reddish-brown, slender, and attain a length of 15 cm. The kernels are brown and often have a bluish-grey, waxy covering, the fracture is flinty. The straw is strong and of a yellowish-red colour. This wheat is early and resistant to cold. Numerous modifications and types suited to various conditions of environment have been obtained from it. These may be divided into three classes, red, white, and brown. The red type is hardy, of vigorous growth, has large ears and ripens relatively late; the white type is more delicate, while the brown, which is much rarer more nearly resembles the red type.

To the Banats group of wheats belong: the Banats wheat properly so-called and the Theiss and Somogyer wheats (the last grows in Slavonia).

G. A.

[564-565]

566. **The Origin and Genetic Composition of Types of Smooth-Awned Barley.**

N. O. VAVILOV Происхождений члздркоотных Яруменей Труды по прикладной Ботанике. Year 12, Part 1, pp. 53-125 table 1, Petrograd, 1922.

The varieties of barley cultivated in Europe and Asia are characterized by the roughness of their awns caused by the presence of epidermal processes anatomically identical with hairs, having cells with a high salicylic acid content.

In 1908, REGEI drew the attention of botanists to the existence of barleys with smooth awns, a structural peculiarity which makes them more suitable for forage, as they are more appetising than awned barleys, and not so apt to stick in the throats of the animals.

At the present time, 19 strains of smooth-awned barleys are known all of which are either two or four-rowed. In agricultural literature, these smooth forms are regarded as loss-mutants due to the sudden suppression of the genetic factor determining roughness, although this hypothesis has not been actually proved.

The present paper contains the results of a series of crosses and genetic analyses made with the object of studying phytogenesis in barley and the origin of forms with smooth awns.

In the F_2 of a rough form, some quite smooth individuals occur, and in certain crosses the number of such individuals is very large while in others it is very small. It is therefore possible to obtain smooth-awned barleys by synthesis. The following table gives an instance of this and summarizes the data referring to the F_2 generation of such crosses between rough barleys which in some cases have produced smooth individuals.

25 crosses were made in all, and the offspring of 13 of these were smooth-awned. In the course of this work it was found that the character "smooth" is dominant to "rough".

In addition to the genetic tests, numerous anatomical and histological investigations were made for the purpose of determining points connected with shape, size and the distribution of roughness. The results showed one important fact viz., that smooth-awned forms only appeared in the hybrid progeny obtained by crossing rough-awned types when the awns of the parental forms possessed certain structural characters.

It was necessary in order to obtain these smooth individuals, for one of the parents to have slender awns with triangular section, and wide-apart, acicular teeth arranged in a close spiral (group *mutans colchicum* and *mutans precocius*), while the other parent must possess broad awns with large, closely-set teeth disposed in a loose spiral and occurring not only on the edges, but also along the external median line of the awn (*coelestis* and *nudoficiens* group).

In many cases, however, in spite of this difference between the parents, the smooth form does not make its appearance, while on the other hand, it may occasionally arise when the differences between the dentition and the awns are not very marked. The problem is evidently complicated.

The numerous crossing experiments (made in 1915 by the author),

between ordinary rough barley and the smooth barleys of Russia and Persia produced smooth and rough individuals in the most varying proportions the F_2 , viz., 5:1 — 7.8:1 — 2.1:1 — 1.6:1 — 0.7:1 — 0.9:1...

The differences obtained in the numeric relations by crossing the various lines of barley reveal the existence of substantial differences in the genetic structure of the various lines and in the number of factors co-operating in the production of roughness.

	Total number of plants	Plants with rough awns	Plants with semi-rough awns	Plants with almost smooth awns	Plants with smooth awns
♀ <i>Hordeum distichum</i> var. <i>nutans colchicum</i> R. Regel × <i>H. vulgare</i> var. <i>coeleste</i> Walpersil R. Regel.	202	149	—	—	53
♀ <i>H. d.</i> var. <i>nutans colchicum</i> R. Regel. × ♂ <i>H. v.</i> <i>pallidum mandchuricum</i> R. Regel. . . .	293	208	4	4	67
♀ <i>Hordeum c.</i> var. <i>pallidum aestivum</i> R. Regel × ♂ <i>H. d.</i> var. <i>zeocritum</i>	79	76	2	—	1
♀ <i>H. v.</i> var. <i>pallidum lapponicum</i> ♂ × <i>H. d.</i> var. <i>nutans praecocius</i> R. Regel.	158	125	11	8	14
♀ <i>H. d.</i> var. <i>nutans colchicum</i> Regel × ♂ <i>H. v.</i> var. <i>pallidum aestivum</i> Regel.	39	30	2	3	4
♀ <i>H. d.</i> var. <i>nutans praecocius</i> R. Regel × ♂ <i>H. v.</i> var. <i>pallidum jarengtranum</i> R. Regel.	105	105	—	—	—

Hence, the genetic formula is no less complicated than the morphological complex discovered by the anatomic study of the awns and dentition.

Many interesting phenomena of attraction and repulsion have been brought out by crossing smooth and rough varieties of barley. A good instance of the latter is afforded by a family belonging to the F_2 generation of the cross No. 145 *Hordeum vulgare* var. *ricotense* Kiarchanum R. Regel × No. 154 *Hordeum vulgare* var. *coeleste* pamiricum Vav.

In this family, segregation is shown by the characters of the grain and of the awns. The combination of these qualities, however, instead of following the law of probabilities, takes place as if there existed some incompatibility, or repulsion, between "covered" grain and rough awns. All the plants with "covered" grain (19 out of 55) had smooth awns.

In other families of the same cross, cases of repulsion not infrequently occurred between smooth awns and "exposed" grain, but they were not so absolute as in the first instance.

Attraction sometimes occurs between the character smooth-awned and two-rows of grain.

Thus, from No. 141 *Hordeum vulgare* var. *pallidum lapponicum* R. Regel \times No. 55 *Hordeum distichum* var. *nutans praecocius* R. Regel, 158 plants were obtained in the F_2 . Of these, 43 were four-rowed barleys, 11 intermediate (but nearer to the four-rowed type), 61 two-rowed (but of a transitional, intermediate type) and 43 typically two-rowed.

As regards the awns, 136 plants had rough awns and 22 smooth-awns.

Of the latter 22, 13 were of the *nutans* type (two-rowed), so there is a certain attraction between smooth awns and two-rows of grain.

Number of genetic factors. — The examination of the third generation reveals the presence of a larger number of factors than could have been expected from the data obtained from the second generation. Thus, in the F_2 generation, only rough plants (134) resulted from the cross No. 36 (*Hordeum distichum* var. *deficiens* \times No. 154 *Hordeum vulgare* var. *coeleste*), while many smooth individuals appeared in the F_3 . In this case, at least, 4 factors must have come into play. If there had only been 3 in the second generation; two out of the 132 plants would have been smooth (according to the ration 63:1). A series of similar facts have led the author to estimate the factors producing roughness at 5, or 6, at the minimum.

The appearance of smooth plants in the F_2 , or F_3 , of rough parents may be regarded as due to the crossing of forms with a different genetic structure from the standpoint of awns.

If we represent the factor of roughness by Z_1, Z_2, Z_3, Z_4, Z_5 , and the absence of roughness of its factor by z_1, z_2, z_3, z_4, z_5 , we shall obtain in the F_2 on crossing a $Z_1, Z_1 Z_2 z_3 z_3$ individual with a $z_1, z_1, z_2, z_2, Z_3, Z_3$ plant, $z_1, z_1, z_2, z_2, z_3, z_3$, individuals all with smooth awns. When the two parents have a larger number of factors ($Z_1, Z_1, Z_2, Z_2, z_3, z_3, z_4, z_4, \times z_1, z_1, z_2, z_2, Z_3, Z_3, Z_4, Z_4$), then naturally, in order to obtain smooth types in the F_2 , it would be necessary to have at disposal a larger quantity of material, since otherwise there would be no probability of obtaining combinations with the character smooth awnness.

Without excluding the possibility that smooth awns may be due to mutation, we are inclined, after what has been said, to attribute their origin to a series of simple and very probable crosses. The barley is generally a self-fertilising plant with closed flowers. Sometimes, however, spontaneous staurogamy takes place, which is facilitated both by the structure of the flowers and by the climate. A hot, dry climate is favourable to anthesis, and thus encourages cross pollinisation, especially in the case of varieties of which the flowers tend to open widely, as for instance *Hordeum spontaneum*, and some varieties of *coeleste* which the author had an opportunity of observing at Saratov, in 1918.

Varieties of smooth-awned barleys have been hitherto found in Persia,

the Caucasus, and South Russia, where the conditions are such as to facilitate cross-fertilisation. These conditions are as follows:

1) Mixed Sowing: The barley crops of these regions are composed of a mixture made up of the most varied forms with two or four rows of grain, black or yellow ears, naked or covered grain.

2) Hot, dry weather from the period of heading.

3) Presence of two or four-rowed varieties which by crossing give rise to the smooth forms: *Hordeum distichum* var. *nutans colchicum*, *nutans praecoxius*; *nudoficiens*, and some types of *coelestes* and *pallidum*.

Thus, it is most probable from the experiments made by the author that smooth-awned barleys have arisen as a result of crosses between rough-awned forms.

G. A.

567. A Probable Loss-Mutation in *Pisum*.

TEDIN HANS. Eine Mutmassliche Verlustmutation bei *Pisum*. *Hereditas*, Vol. VI, Parts 1-2, pp. 33-43. Lund, 1923.

The Schrot pea is a strain of *Pisum arvense* with the usual characters of the species viz., red flower, large, red, somewhat wrinkled seeds with spermoderm of different shades ranging from greyish-yellow to brownish-grey.

By means of pedigree selection, numerous lines were obtained from this strain one of which, No. 0.301 is worthy of special attention; it is distinguished by having a smooth skin and a transparent, almost completely colourless spermoderm, the only character that recalls *arvense* being a small triangular brownish-grey patch above the chalaza. From this patch two narrow strips of the same colour are given off that develop at a certain distance one on each side of the hilum.

The colour of the flowers in *Pisum arvense* is due to three factors: *A*, *B* and *C*. *A* which is the basal colour factor produces of itself a bright purple tint; *A* + *B* gives pink; *A* + *C*, violet; *A* + *B* + *C* normal red.

In the case of the spermoderm, two factors *G* and *y*, would appear according to the author, to come into play. The first when in conjunction with *A* would seem to act as a relatively weak chromogen giving rise to a slight brownish coloration, while the other which is inactive alone, accentuates the colour to a dark brown.

G and *A* are connected, or actually identical. The crossing experiments made by the author have revealed the presence of a third factor *G*₁ in the absence of which the coloration of the spermoderm is reduced to the two bands characteristic of 0301.

In the same manner, in order to obtain the wrinkling of the seeds it would be necessary in addition to the factors *L*₁, *L*₂. (Tschermak) to have also *C*.

If *C* is lacking in the genetic complex of *arvense*, we have a type with characters corresponding exactly to the line 0301.

The origin of this line may be explained by regarding it as a loss-mutation due to the lack, or inaction, of the factor *C*.

G. A.

[541]

568. New Observations on the Genetics of Peas.

PELLEW, CAROLINE and SVERSRUP ASLAUS, *Journal of Genetics*, Vol. 13, No. 1, pp. 125-131, figs. 4. Cambridge, March 1923.

This paper gives the results obtained by a genetic study of two varieties of peas (*Pisum sativum*).

1) *Variety with reduced stipules*. — This variety is distinguished by possessing stipules little larger than those of *Lathyrus*. It was obtained from a mutant discovered in 1915 amongst the plants in a row of Duke of Albany peas. From the seeds of this plant were raised 20 seedlings all with reduced stipules. This reduction appears to be connected with a greater development of the leaflets. Crossing this form with the Duke of Albany gave normal types in the F_1 , while the F_2 was composed of normal individuals and plants with reduced stipules in the proportion of 3 : 1.

S represents the factor producing normal stipules (s standing for reduced stipules) and is linked with the purple colour B as can be deduced from the hybrids resulting from the cross $Bs = bS$. The percentage of cross-overs is 28.

2) *Variety with keeled alae*. — The alae are modified, having the structure and appearance of the keel; the structure of the flower is normal in other respects.

K, normal alae (k = keeled wings) is correlated with G, glaucous colour (g = emerald green). The percentage of cross-overs is 20.

No correlation exists on the other hand between S and G; S and K are therefore situated in two different chromosomes.

K and S, are in their turn independent as regards the following genetic values.

linked round-wrinkled seeds, tendrils, leaves acacia type.
 stem tall-dwarf
 stem normal-fasciate
 flowers-white-coloured
 cotyledons yellow-green.

Thus we have for *Pisum* three linkage groups (the haploid number of chromosomes is 7).

- 1 { seeds, round-wrinkled
 { tendrils, leaves acacia type
- 2 { flowers, purple-salmon
 { stipules normal, stipules reduced
- 3 { glaucous-emerald-green
 { normal alae-keeled alae.

In the course of his work on the colour of the cotyledons and pods, the author discovered a series of interesting facts that can be explained by assuming the existence of a triple series of allelomorphs: 1) yellow cotyledons (dominant character) associated with green pods; 2) green cotyledons associated with green pods; 3) pale-green cotyledons associated with green pods.

G. A.

569. **On the Genetic Characteristics of the Gametes of the Sweet Pea.**

HAMMARLUND, C. Über einen Fall von Koppelung und freie Kombination bei Erbsen. *Hereditas*, Vol. IV, Pts. 1-2, pp. 235-238. Lund, 1923.

Two pure lines of the sweet pea were employed:

- 1) *Pisum sativum saccharatum* (Plots 306-18) distinguished from the common sweet pea by the white petals and golden coloured hood.
- 2) *Pisum arvense saccharatum* (Plots 460-18), petals violet and green seeds.

Cross A. The F_1 of the cross ♀ 306-18 × ♂ 460-18 consisted of 10 individuals with violet petals and green seeds and in F_2 a fourth consisted of normals with violet flowers and green pods; violet petals and yellow seeds; white petals and green seeds; white petals and yellow seeds, in the following ratios 9:3:3:1. The difference between the two lines is evidently due to two independent genetic factors.

Cross B: ♀ 306-18 ♂ 460-18; the ♀ parent the same as the preceding cross; the ♂ parent various, but coming from the same mother stock as the ♂ parent in Cross A, and morphologically identical. In F_1 the hybrids gave violet petals and green seeds; in F_2 , however, the proportion was distinctly variable: 226 violet-green; 2 violet-yellow: 4 white-green and 83 white-yellow. The predominant characters are violet-green and white-yellow.

Cross C: ♀ 460-18 × ♂ 306-18.

The F_1 , gave similar results to cross B 201:3:4:70.

In crosses B and C therefore, there is an evident correlation "Koppelung" between the two factors with violet petals and violet coloration of the seeds, in such a way that the gametes show a predominance at least four times superior to that of the gametes responsible for the white coloration of the petals and the yellow coloration of the seeds.

G. A.

570. **The Genotypic Relations between the Wild Form, *Linum angustifolium* and the Cultivated *L. usitatissimum*.**

TAMMES TINE. Das genotypische Verhältnis zwischen Idem Widen *Linum angustifolium* und dem Kulturlein, *Linum usitatissimum*. *Genetica*, Year V, Part 1, pp. 61-70, table 1. The Hague, January 1923.

Seven factors: A, B, C, D, E, F and H, are involved in the colour of the petals and of the anthers of the cultivated variety of flax (*Linum usitatissimum* L.) B' and C' are the basal determinants of the colour of the flowers, the presence of both being necessary in order for the petals to be tinted. H in combination with the two preceding factors imparts a blue colour to the anthers and the pollen, while the effect of all the other factors is to intensify the coloration, or produce different shades.

Taking this point as a basis, the author has begun a series of similar genetic determinations in the case of wild flax *Linum angustifolium*, which, like the cultivated variety, has a diploid number of 30 chromosomes. In the wild flax also, seven genetic factors have been determined for the colour

of the petals (A^a , B^a , C^a , D , E , F^a and H) and one other factor has also been found in the case of both species (K and K^a respectively).

The factors met with in the two species are very similar not only as regards the characters they determine, but also from the point of view of the reciprocity of their effects. In so far as the difference amongst the factors is concerned, this is of three kinds:

- 1) qualitative: the shade of colour produced by B^1 and C^1 with F differs from that due to B^a C^a and F^a ;
- 2) quantitative: B^1 , C^1 with F give a darker shade (the colour is the same, but its intensity is greater) than B^a C^a and F^a ;
- 3) differences as regards the dominance of the characters.

The differences that exist between the factors of *L. usitatissimum* and *L. angustifolium* do not prevent any factor in either complex being replaced by the corresponding factor in the other complex, the action of the rest remaining unchanged. Hence, it is possible by crossing the two species to obtain all the possible combinations, and since the two forms are distinguished by five factors, the genotypes in the F_2 will amount to $3^5 = 243$. Further, the incomplete dominance of the factors causes corresponding phenotypic differences while the great oscillations to a certain extent remove the limits between the different phenotypes. The absence of well-defined F_2 groups made the work of genetic analysis very difficult. The author has already mentioned the great similarity between these two species of flax:

- 1) Both are homostylic (all other varieties are heterostylic).
- 2) The greater the space at the disposal of the plant, the larger are the number of branchings at the base in both species.
- 3) These are the only two species of the genus *Linum* that can be successfully crossed.

Another point of likeness is the identity in the number of chromosomes, to which must now be added the unity of the genotype for the flower colour. In spite of the considerable phenotypic differences, the fact that the corresponding genotypes are composed of the same factors, or of allelomorphs, is a proof of the existence of a fairly close degree of relationship between the wild and the cultivated species.

The author is continuing his work and hopes soon to be able to give some results relating to the colour of the seeds, leaves and stem; the branching, length of stem, productiveness, duration of life, etc.

G. A.

571. Crosses between two Varieties of Cucumber, Znaim Gurke and Noa's Treib.

048 BECKER J. Über Vererbungsgesetze bei Gurken. *Zeitschrift für Pflanzenzüchtung*, Vol. VIII, Part. 3, pp. 290-293. Berlin, 1922.

This paper gives the results obtained by a cross between two varieties of cucumber, the Znaim cucumber and Noa's Treib, the maternal parent being the former. The Znaim cucumber grows in the open and is especially cultivated by the inhabitants of Znaim in Moravia; it is oval,

and has no neck; average length 18 cm.; circumference 28.5 cm.; weight 650 gm. The colour of the fruit is at first dark-green without stripes, but it turns yellow when ripe, the skin is glossy and bears a few black spines.

The paternal parent used in the cross, Noa's Treib, grows in a hot-bed. This variety was put on the market by Dümpele, in 1880 at Erfurt. Average length of fruit 65 cm., circumference 35 cm.; weight 4 kg. Colour green at first, later white. The skin is glossy with a few white spines.

We have therefore the following groups of colours:

Small fruit	Very large fruit
Green skin	White skin
Black spines	White spines

The F_1 and F_2 were grown in the open. The hybrids of the F_1 had striped, greenish-white fruits turning white when mature. The length ranged from 39 to 41 cm.; the circumference from 31 to 32 cm. and the weight from 1810 to 1910 gm. The spines were white. They thus showed characters intermediate between those of their parents.

In the F_2 , 76 individuals were obtained, the length and colour of these being as follows:

35-40 cm. long, white	44 plants
35-40 " " yellow	15 "
15-20 " " short, white	11 "
15-20 " " " yellow	1 plant
20-35 " " intermediate white	3 plants
20-35 " " yellow	2 "
<hr/>	
76 plants	

Leaving out of account the five plants of intermediate length due in the opinion of the author to the local action of the medium, we have: long-white; long-yellow; short-white; short-yellow =

$$44 : 15 : 11 : 1 = 9 : 3 : 3 : 1$$

This gives the scheme of a dihybrid, the long shape being dominant as regards the short, and white dominant in respect to yellow (at maturity).

The objects of the cross which were to obtain a type of out-door, hardy cucumber with large well-formed fruit turning yellow when ripe, may thus be said to have been attained. In some of the individuals of the F_2 (1/16 of the progeny of F_2) and of later generations these groupings of characters should remain constant. G. A.

572. Self-Sterility in Chinese Cabbage (Pe Tsai).

YOICHI KAKIZAKI, *The Journal of Heredity*, Vol. XIII, No. 8, pp. 374-376, fig. 1. Washington. D. C., December, 1922.

The experiments conducted by the author showed that, whereas cross-pollination gave rise to great fertility, self-pollination caused a high degree

of sterility, only 30 % of the self-fertilised flowers produced normal fruit, 27 % of the fruit being imperfect, while 50 % of the flowers did not set at all.

These results were obtained both when the pollen used was from the same flower, and when it came from the same, or other inflorescences of the same plant. In the experiments taken as a whole, very great individual variations were noticed; these ranged from almost complete self-sterility to a very high degree of self-fertility which would incline us to suppose the existence of lines endowed with different grades of self-sterility.

When cross fertilisation was effected, the percentage of flowers that set reached 96. G. A.

Seeds.

573. The Minimum Temperature of Germination of Seeds.

COFFMAN, F. A. (Office of Cereal Investigations, Bureau of Plant Industry, U. S. Dep. of Agr.) *Journal of the American Society of Agronomy*, Vol. XV, No. 7, pp. 257-270, bibliography. Albany, N. Y., 1923.

Little information apparently exists upon the subject of minimum temperatures of germination of seeds of most of our commonly grown plants. The author's objects in these experiments were to determinate: 1) The minimum temperatures at which seeds of different common crop plants would germinate; 2) the minimum temperatures at which satisfactory percentages of germination may be expected and the variations between such temperatures in different crops; 3) whether lower temperatures than those commonly used in seed testing laboratories would be beneficial in the germination of seeds.

Seeds of different species germinate very differently at different temperature. Within a given species, starchy seeds appear to be unable to resist low temperatures to the same degree as the more oily seeds, without injury and reducing germination percentages. All of the small grains will germinate at the temperature of melting ice. Oats appear to be more affected by low temperatures than the other small grains. The strength of germination under freezing conditions appear to be in the following order: barley, rye, wheat, oats. It has been noticed that under field conditions spring barley and rye will germinate more quickly than spring wheat and oats during seasons of low temperatures. Of the sorghums, the softer and more starchy varieties appear less able to withstand low temperatures than the harder seed types. Of our commonly grown crops, the seed of alfalfa and the clovers will germinate more readily at low temperatures than any of the others. From the results obtained in these tests it appears that it would be advantageous to use lower temperatures for the germination of alfalfa, clovers, and cereals than those now employed in seed testing laboratories.

D. v. S.

574. **Experiments in Dressing Seeds.**

LEGGIERI, L. (R. Scuola Superiore di Agricoltura di Portici, Laboratorio delle Coltivazioni). Preparazione dei semi prima della semina. Esperimenti colla canapa e col granturco. *Il Coltivatore*, Year 69, No. 24, pp. 170-175, No. 25, pp. 206-212. Casale Monferrato, 1923.

The author has tested the following treatments in the case of hemp ("nostrana" variety), and maize ("giallo comune").

I. Immersion for 6 — 12 — 24 hours in: water; 1 % and 3 % solutions of sulphate of potassium; 1 % and 3 % solutions of ammonium sulphate; 2) Coating them with meat-meal + plaster.

He ascertained that: 1) the immersion of the seeds in water has a good effect; 2) the action of the salt solutions varies according to the seed, nitrate solutions having a favourable effect upon maize seed, and sulphate solutions suiting hemp seed best; 3) coating the seeds with an organic substance gives good results; 4) the duration of the immersion is a matter of great importance, hence the length of time needed must be found experimentally for each species, and perhaps for each strain, before any certain data can be obtained.

F. D.

575. **Drying and Cleaning of Sugar Beet Seeds.**

DESPREZ, F. (Directeur de la Station expérimentale agricole de Cappelle, Templeneuve) I. Culture de la graine de betterave sucrière. *Journal d'Agriculture pratique*, Year 87. Vol. II, n. 32, pp. 110-112. Séchage et nettoyage des graines de betteraves sucrières. *Idem*, Vol. II No. 35, pp. 170-172. Paris, 1923.

The unsatisfactory germination of sugar beet seeds has frequently been attributed in France to climatic conditions, excess of humidity, etc.

The author considers, however, that insufficient attention has been given to seed drying appliances and selection of seed. A test was made with seeds cleaned and dried before sowing, with threshed undried seed, and with seed merely dried. The seed threshed late and left undried gave a germination as low as 30 % whilst the dried samples showed a germination percentage of 75 %. Certain drying machines in use have proved ineffective owing to incomplete drying. Attention is drawn to the fact that seed is often considered dry prematurely from the appearance of the seed coat; the author states that all seed with a moisture content of 15 % requires further drying.

The losses incurred through inadequate drying have resulted in the formation of a Commission appointed by the Ministry of Agriculture in France with a view to the improvement and generalisation of special drying processes for sugar beet seeds. The Tripette and Renaud drier has proved satisfactory in various seed establishments and are recommended. These consists of a bin divided into 3 sections in each of which is placed an octagonal iron cylinder; the speed of rotation is regulated as required.

[574-575]

External fixtures direct the seeds towards the outlet and the rate is controlled according to the degree of humidity. The seed is eventually passed along into a hopper placed above a dryer and by means of a projector is pushed into the upper cylinder. It passes successively through 3 cylinders, a warm air current being directed through each; a ventilator is so arranged as to allow the warm air to escape through a chimney, and pipes and taps serve to regulate the direction of the current. The temperature may be controlled by inlets in the different sections.

A preliminary cleaning is advisable, to remove pebbles, twigs, etc. The actual drying process demands constant supervision as it is advisable to maintain the moisture content of the seeds at about 14 %. SAILLARD (General Secretary for the Commission) states that the gas currents give better results than the stove or kiln. To ensure simultaneous drying for all the seeds will depend largely on the type of drier, stage of ripeness, and degree of humidity and air circulation. Well matured seeds not too moist, readily withstand a high temperature. Experiments were made to test the influence of heat on germination of sugar beet seed. Three grades of seed were examined. A temperature above 80° C. will destroy inferior seeds and should serve as an adequate test for selecting good seed; kept for 1 hour at 80° for 14 days had no effect on germinating capacity of first quality seed although naturally it had a somewhat retardive effect. These results are only applicable to the effect of heat on vitality and not as regards preservation of the seed coat etc.; too high a temperature besides lowering the rate of germination will make the seeds excessively dry and brittle.

After drying, the seeds are passed through a grader, the sieve retaining only seeds of 2.5 mm. and a tilted sheet so arranged as to finally direct the inferior and good quality seed into their respective sections. Before putting into packets, the seed is placed in a thin cloth and exposed to the air to ensure elimination of any dust particles.

M. L. Y.

BIBLIOGRAPHICAL NOTES.

576. AUCHINCLOSS, G. G. DRIEBERG, J. G. and KADRAMER, R. D. Calculation of the Probable Soil Error in Paddy Trials. *The Tropical Agriculturist*, Vol. LX, No. 5, pp. 275-279, Tables 4, fig. 1. Peradinya, Ceylon, 1923.

The authors give an account of work carried out at Peradinya to determine the errors which arise from initial differences of fertility in various parts of a field, and lessen the value of comparative experiments. A frequency curve of the yield from the paddy plots is given and the average deviations, standard deviations and probable errors, obtained in the trials with various groupings of plots are set out in a table, so that comparison may be made.

W. S. G.

577. ARND, TH., Ein neues Verfahren zur vergleichenden Bestimmung der Kohärenz mineralischer Böden. (New Method of determining the Cohesion of Mineral Soils). *Zeitschrift für Pflanzenernährung und Düngung (wissenschaftlicher Teil)*, Vol. II, No. 2, pp. 130-149, figs. 8. Leipzig, Berlin, 1923

The author describes a new method of determining the cohesion of mineral soils, by means of an apparatus he has devised with which he estimates the resistance to friction. One prism and one cylinder made from the soil to be tested are fixed in the apparatus. By means of a rotory movement, the cylinder is rubbed against one of the surfaces of the prism. The author distinguishes cohesion coefficients of the first, second and third order, according to the duration of the rubbing, the pressure applied and the rapidity with which the cylinder rotates.

D. v. S.

578. HENDRICK, J. and NEWLANDS, G. (Soil Research Department, University of Aberdeen, Scotland). The Value of Mineralogical Examination in determining Soil Types, with a Method of Examination and a Comparison of certain English and Scottish Soils. *The Journal of Agricultural Science*, Vol. 13, No. 1, pp. 1-17, fig. 1. bibliography. Cambridge, 1923.

The method of mineralogical analysis of soils is discussed as a useful means of examination for the purposes of classification; the results of the analyses are discussed and English and Scottish soil types compared.

D. v. S.

579. JOSEPH, A. H., and MARTIN, F. J. (Wellcome Tropical Research Laboratories, Khartoum). The Moisture Equivalent of Heavy Soils. *The Journal of Agricultural Science*, Vol. 13, No. 1, pp. 49-59. Cambridge, 1923.

The experiments here described were carried out on soils of the northern Sudan; their aim was to find the relation between moisture equivalent and such additional important soil properties as salinity and alkalinity.

D. v. S.

580. LINDEMAN, J., (School of Agriculture, Aas, Norway). Untersuchungen ein Eisenhydroxydsol; ein Fall negativer Osmose (Correlation between Osmotic Pressure and Concentration of Colloidal solution of Iron Hydroxydsol). *Kolloid-Zeitschrift*, Vol. 32, No. 6, pp. 376-383, figs. 3. Dresden-Leipzig, 1923.

This physico-chemical study, also of interest from the physiological standpoint, is concerned with the correlation between osmotic pressure and the concentration of a colloidal solution of iron hydroxydsol. It refers to a case of negative osmosis.

D. v. S.

581. ARND and TACKE. Physikalische und chemische Studien an schweren Tonböden. (Clay Soils from the Physical and Chemical Standpoint) *Internationale Mitteilungen für Bodenkunde*, Vol. XIII, Nos. 1-2, pp. 6-26. Berlin, 1923.

The authors have studied clay soils from both the physical and the chemical standpoints, and have also tested the effect of liming on certain physical properties of the soil, such as specific gravity, hygroscopicity, plasticity etc. Subsequently, they investigated the functions of alumina, silicic acid and bases in connection with phosphatic fertilisers. The soils studied are those of the marshes in the German coast of the North Sea. The results obtained were to a considerable extent negative.

D. v. S.

582. MACINTIRE, W. H., and YOUNG, J. B. The Transient Nature of Magnesium-induced Toxicity and its Bearing upon Lime-magnesia Ratio Studies. *Soil Science*, Vol. XV, No. 6, pp. 427-471, 5 plates, bibliography. Baltimore, 1923.

It is pointed out that if plant culture experiments relative to the effects of the more active forms of magnesium are continued over a period of years, it may be true in many cases, that an initial period of toxicity may be converted into a period of beneficial results, as was found to be the case in the author's experiments.

D. v. S.

583. WESTER, D. H. Über den Mangangehalt einiger holländischer Bodenarten und einige Bemerkungen dazu. (Manganese Content of Dutch Soils). *Internationale Mitteilungen für Bodenkunde*, Vol. XIII, Nos. 1-2, pp. 1-5. Berlin, 1923.

The author has determined the manganese content of a series of types of Dutch soil. There had been no data previously on this subject. It was found that the most fertile soils contain the largest amount of manganese, and that the ash of cultivated plants has a higher percentage of manganese than the soils themselves.

D. v. S.

584. WHITTLIS, C. L. (School of Agriculture, Cambridge). The Determination of the Number of Bacteria in Soil (Preliminary Communication). *The Journal of Agricultural Science*, Vol. 13, No. 1, pp. 18-48, plates 3, fig. 5, bibliography. Cambridge, 1923.

The author criticizes the usual shaking methods, for the determination of the number of bacteria in soil, which have been examined and found unsatisfactory. The most striking result of the use of the vibrator, was the fact that the colonies grew so quickly. It is suggested that this is due to the organism having been freed from the enveloping colloidal gels, in which they are normally embedded.

D. v. S.

585. KOCH, A. and OELSNER, Alice. (Agricultural Bacteriological Institute, University of Göttingen, Germany). Über nucleoproteid spaltende Bakterien und ihre Bedeutung für die Erschließung des Phosphorkapitals. im Ackerböden. (Nucleo-proteins Bacteria and the Effect on the Transformation of Phosphorous, into Available Phosphate Compounds). *Biochemische Zeitschrift*, Vol. 134, Nos. 1-4, pp. 76-96. Berlin, 1922.

The authors have designated the soil bacteria which transform the phosphorous content of the organic nucleo-protein compounds into available plant phosphates as *Nucleobacter*. The action of these bacteria is accelerated when lime is added to the soil. D. v. S.

586. HEYMONS, R. (Zoological Institute of the Higher Agricultural School of Berlin). Der Einfluss der Regenwürmer auf Beschaffenheit und Ertragsfähigkeit des Bodens. *Zeitschrift für Pflanzenernährung und Düngung (wissenschaftlicher Teil)*, Vol. II, No. 2, pp. 97-129, bibliography. Leipzig, Berlin, 1923.

An account of the influence of earthworms on soil structure and fertility. D. v. S.

587. CURIE Mdme. Electroscope pour la mesure de la radioactivité des engrais. (Electroscope for the Measurement of Radioactivity of Fertilisers). *Annales de la Science Agronomique*, Year 39, No. 5, pp. 267-264, figs. 1. Paris, 1922.

588. THOMAS, W. (Pennsylvania Agr. Exp. Station). Ultimate Analysis of the Mineral Constituents of a Hagerstown silty clay loam Soil and occurrence in Plants of some of the Elements found. *Soil Science*, Vol. XV, No. 1, pp. 1-18, bibl. 76, publ. Baltimore, 1923.

This paper gives an account of the preliminary work carried out on soil used in an intensive apple fertilizer experiment. The rarer elements, vanadium, chromium, molybdenum, zirconium, rubidium, caesium and lithium have been isolated and identified. The question is raised: how do such relatively large amounts of the rarer elements become absorbed and assimilated by plants, and what function, if any, do they possess? The investigations are being continued. D. v. S.

589. KLITSCH, C. Die Wirkung einseitiger Düngung auf die Gestaltung der anatomischen, insbesondere der mechanischen Verhältnisse in Roggenhalmen. (Effect of Fertilisers on Anatomical and Mechanical Composition of Haulms of Cereals) *Zeitschrift für Pflanzenernährung und Düngung (wissenschaftlicher Teil)*, Vol. 2, No. 4, pp. 249-292, figs. 1, bibliography. Leipzig, Berlin, 1923.

The author treats of the effect exercised by the respective fertilisers upon the composition of the haulms of cereals, from the anatomical

and mechanical standpoints. The hardening of the haulms with a view to the keeping qualities of the straw is the principal subject of discussion.

D. v. S.

590. ADINARAYAN RAO, K. Preliminary Account of Symbiotic Nitrogen Fixation in Non-Leguminous Plants with Special Reference to *Chomelia asiatica*. *The Agricultural Journal of India*, Vol. XVIII, Pt. II, pp. 132-143. Calcutta and London, 1923.

Report of investigations with leaf nodules of *Chomelia asiatica* and *Pavetta indica*, non-leguminous species common in Southern India, suitable as green manures. Examples of plants of other orders such as Rubiaceae, Myrsinaceae and Casuarineae are mentioned in this respect, and reference is also made to certain plants in temperate climates, e. g. *Alnus* spp., *Cycas circinalis*, *Elaeagnus latifolia*, and *Podocarpus latifolia*, which may be included in this category.

M. L. Y.

591. ROBERTSON and DICKSON The Valuation of Insoluble Phosphates by Means of a Modified Citric Acid Test. *Chemistry and Industry*, Vol. 42, No. 8, pp. 59-66. London, February 1923.

D. v. S.

592. HALL, T. D. The Nitrogen Problem. *The Farmer's Weekly*, Vol. XXV, No. 642, pp. 1562-1563. *Idem*, Vol. XXV, No. 646, pp. 1944-1947, figs. 6. Bloemfontein, 1923.

This article deals with the chemistry of certain South African soils, and the related factor of fertilisers. In the second part the results of experiments are given respecting the nitrification values of various soils, and deductions made from the data obtained. Graphs illustrate seasonal variations of nitrates, rainfall, soil and air temperatures, and the nitrogen content of soils treated in different ways.

W. S. G.

593. CANNON, W. A., Plant Habits and Habitats in the Arid Portions of South Australia. *Carnegie Institution of Washington, Publication No. 308*, pp. 1-139, plates 32, figs. 31, bibliography. Washington, 1921.

The author gives a complete survey of the general physiological conditions of Australia, the climatic features and the vegetation and plant habitats in the arid portions in the south. Full details are included concerning the morphological characteristic of the plants and certain reactions and adaptations to different areas (reactions to light, temperature, low water-supply, physical nature of the soil). The numerous plates illustrate the conditions and habits very effectively.

M. L. Y.

594. BRAUN-BLANQUET, J., and WILCZER, E. Contribution à la connaissance de la Flore Marocaine. (Moroccan Flora). *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord*, Vol. XIV, No. 5, pp. 191-197; No. 6, pp. 212-226. Algiers, 1923.

General review of the various botanical expeditions made in different parts of Morocco and lists of the plants collected.

F. D.

595. MAXIMOW, N. A., (Botanical Garden, Petrograd) Physiologisch-ökologische Untersuchungen über die Dürre-resistenz der Xerophyten. (Investigations on the Resistance of Xerophytes to Drought). *Jahrbücher für Wissenschaftliche Botanik*, Vol. 62, No. 1, pp. 128-144, bibliography. Zusses Leipzig, 1923.

An ecological investigation dealing with the resistance to drought of xerophytes, plants common in the desert and the steppes, and including also certain of the now-cultivated plants. Experiments were started at Tiflis in 1913 in a laboratory established by the author and which is still being carried on to study the flora of the Caucasus. D. v. S.

596. LUNDEGARDH, H. (Lund, Sweden). Pflanzenökologische Lichtmessungen. (Measuring the Intensity of Light). *Biologisches Zentralblatt*, Vol. 43, No. 4, pp. 404-431, figs. 10. Leipzig, 1923.

The author describes an apparatus for measuring the intensity of light. In his ecological work, he studies the intensity of sunlight and the temperature and moisture of the air, and also, light in forests, as well as direct and reflected light which are important for plant assimilation and respiration. D. v. S.

597. PRAT, S. (Institut pour la physiologie des plantes de l'Université Tchèque à Prague). Die Elektrolytaufnahme durch die Pflanze; die Resorption von Mineralstoffen durch die Wurzeln. (Electrolytes and the Absorption of Mineral Substances by Plant Roots). *Biochemische Zeitschrift*, Vol. 136, Nos. 4-6, pp. 366-376, figs. 2. Berlin, 1923.

Assimilation of mineral substances by plant roots. The absorption of electrolytes apparently depends very little on transpiration. D. v. S.

598. SMIRNOW, A. I. (Laboratory of Agricultural Chemistry of the Agricultural Academy of Petrowskoje-Resumoskoje near Moscow). Über die Synthese der Säureamide in den Pflanzen bei Ernährung mit Ammoniumsalzen. *Biochemische Zeitschrift*, Vol. 137, Nos. 1-3, pp. 1-34, figs. 6. Berlin, 1923 (1).

The author studies the synthesis of amido-acids in plants supplied with ammoniacal salts. D. v. S.

599. FOLSOM, D. Mutations of the Potato. *Journal of Heredity*, Vol. XIV, No. 4, pp. 45-48, figs. 2. Washington, D. C., 1923.

Description of a simple-leaf sport of the Green Mountain variety of potato found in northeastern Maine in 1920. This sport in the third generation (consisting of a one-stalked plant), apparently reverted, partly to a compound leaf condition, two leaves being divided longitudinally, but its five tubers produced ten plants that were all simple-leaved. G. A.

(1) See also: PRIANTSCHNIKOW, Über den Aufbau und Abbau des Asparagins in den Pflanzen. *Ber. Deutsch. Botan. Ges.* 40, 242, 1922. (Ed.)

CROPS IN TEMPERATE AND TROPICAL COUNTRIES

SYNTHETIC ARTICLES.

600. Cultivation and Fodder Value of Kudzu (*Pueraria Thunbergiana*).

I. — ARNOLD, H. C. (Agricultural Experiment Station, Salisbury). Propagation of Kudzu Vine. *Bulletin No. 429, Department of Agriculture, Rhodesia*, pp. 1-4. Salisbury, 1922.

II. — McMARTIN, H. Kudzu. A remarkable Fodder Plant. A Queensland Farmer's Observations. *Queensland Agricultural Journal*, Vol. XVIII, Part 5, pp. 365-366 and pp. 367-368. Brisbane, Nov. 1922.

III. — LEACH C. F. Beggar Weed and Kudzu Vine. *Rhodesia Agricultural Journal*, Vol. XIX, No. 3, pp. 288-290. Salisbury, June 1922 reprinted from *Hoard's Dairyman*. Wisconsin, 1922, with foreword by the Editor of the *Rhodesia Journal*.

The value of kudzu (*Pueraria Thunbergiana*) as a forage crop has already been reported (1) but the increasing practical value has recently been confirmed in Rhodesia, Queensland and Wisconsin (U. S. A.).

I. — As regards cultivation, very little attention is required but the propagation presents certain difficulties. H. C. ARNOLD has, therefore, described the methods found to be most successful in Rhodesia. Sowing *in situ* is not advised, except where special attention can be given to water supply and protection from leaf-eating insects. Transplanting from small tins has given more satisfactory results but care should be taken to keep soil and roots intact as kudzu seedlings are very easily damaged. Propagation by means of layers is practicable when the plant is once established, especially the unrooted slips system, planted direct in the permanent position and selected from near the parent root stock.

II. — The adaptability of kudzu to Queensland conditions has been proved during the past year. The plant has been tested under the most severe conditions of heat, drought and frost and the reports are excellent. The rapid growth and deep-rooting system are evident advantages. The benefit of propagation by layers is confirmed, and planting in damp soil is advised.

As regards value as stock feed, experiments in Queensland bear out the reports from the United States, namely that kudzu will furnish sufficient fodder (as much as 10 tons per acre) for 6 milch cows to the acre when grown on trellises 12 ft. apart. Tests have been made with sheep and lambs and results demonstrate the remarkable effect on ewes fed chiefly on kudzu and sweet potatoes. The improved quality of milk and the live weight of the lambs was noticed. One ram lamb 50 days old weighed

(1) See R. 1921, No. 151. (Ed).

53 lb. and a ewe lamb 54 lb.; kudzu is also apparently a very palatable fodder. A further point of interest lies in the fact that sheep which had become anaemic, recovered with unusual rapidity when thus fed.

III. — Reports by C. F. LEACH (U. S.) show that kudzu is recognised as a valuable forage crop in Florida (U. S.), for cows left on nothing but kudzu pasture for as long as 7 consecutive months (from April onwards) keep fat and sleek; an excellent winter roughage is also formed which is considered to be very nutritious.

This report has been utilised by the Department of Agriculture in Rhodesia to emphasise the value of this crop. Experience has already confirmed the high opinion formed of kudzu and its suitability to Rhodesia. If a legume can assist in solving the great problem of all the year succulent and nutritious grazing, it is deserving of being grown on every occupied farm and ranch and once its value is realised and proper attention given to propagation, it is considered probable that kudzu may do for Rhodesia on a limited scale, what lucerne has done for instance for the Argentine.

M. L. Y.

601. Cotton Growing in the Anglo-Egyptian Sudan and the Belgian Congo.

I. — Replies to Questionnaire, sent to the International Institute of Agriculture, by the Director of Agriculture, Khartoum, December 26, 1921.

II. — Annual reports of the British Cotton Growing Association for 1921 and 1922 (Manchester).

III. — Monthly Reports of the Commercial Intelligence Branch, Central Economic Board of the Sudan Government, January to July 1923, Khartoum.

IV. HIMBURY, W. H., India and the Sudan as Sources for increasing our raw Cotton Supplies (*British Cotton Growing Association* p. 26 et seq.). Manchester, August 1923.

V. — The Cotton Growing Countries, Production and Trade, *International Institute of Agriculture*. Rome, 1922, p. 107, Anglo-Egyptian Sudan.

VI. — *Renseignements de l'Office Colonial du Ministère des Colonies de Belgique*. December 1921 and June 1923. Brussels.

VII. — *Notes sur la culture du Coton au Congo Belge, Compagnie Colonnière Congolaise*. October 1922, Brussels.

VIII. — "Congo". April 1923, pp. 608-610; June 1923, p. 142. Brussels 1923.

IX. — "The Cotton Growing Countries", *International Institute of Agriculture*, 1922. Belgian Congo, p. 87.

THE ANGLO-EGYPTIAN SUDAN.

I-V. — The Sudan includes the whole of the Upper Valleys of the Nile, with the exception of the equatorial lake region of the Protectorate of Uganda. The course of the Blue Nile from the Abyssinian frontier to its junction with the White Nile at Khartoum is in Sudanese territory.

The introduction of cotton as a commercial crop is quite recent, though native cultivation took place to some extent in earlier times, when the crop was devoted to domestic purposes. At present cotton is grown in many parts of the country, and is dependent for the necessary water supply on three main physical agencies. In the provinces of Berber and Dongola relatively small areas are utilized by means of pumping stations which draw water from the Nile. Along the course of the Blue Nile much larger works of the same description have been established or improved, and the area under cotton at Tayiba, Hosh and Barakat is now considerable. Near the shores of the Red Sea, the river Baraka comes down in flood from the mountain streams of Erythrea, and annually inundates a delta of varying extent in the Tokar district. The river Gash, originating also in Erythrea, forms year by year below Kassala a flood delta 50 miles in length, and afterwards disappears among the desert sands. The flooded areas vary greatly in extent, but the crops grown thereon frequently form a great proportion of the Sudan cotton yield.

Some plantations, partly experimental, occur in the Bhar-el-Ghazal and in the Kordofan provinces, where rainfall is usually sufficient for cotton growing.

Three methods of cultivation (Nile pumps, flood water, and rainfall) are therefore being followed at the present time.

The rainfall north of Khartoum is only about 3 inches (75 mm.) per annum, but south of Sennar (on the Blue Nile) it is about 20 inches (500 mm.) and in the Bahr-el-Ghazal about 40 inches (1000 mm.); and though swamps and sandy deserts are extensive, there is an immense territory available for cotton as well as for other crops.

The population of the Sudan was at one time estimated at 10 million, but the devastations of the Mahdi and the Khalifa reduced the number to about 2 million. With the present settled administration a good recovery has been made, a population of about 5 1/2 million being now recorded. Large areas formerly cultivated for food crops had consequently been abandoned, and in some instances cotton is now substituted.

The Tokar district (Red Sea Province), in spite of the variation in the area flooded annually by the river Baraka, presents the characteristics of a definite cotton-growing area, though limited in extent by the surrounding desert. Owing to the district's proximity to shipping facilities, transport difficulties are few, and, after the floods subside, the alluvial soil retains sufficient moisture to allow all the cotton to ripen in any season not specially unfavourable. Hot winds have occasionally caused growers to despair of their crops, and an instance is recorded where a year or two ago, a Greek family abandoned their cotton plantation and left the district. Some months later, a large advance in the price of cotton induced them to return to see what could be saved. They found an excellent and very profitable crop ready for picking.

The 1913 yield of lint in the Tokar district was about 1650 metric tons, and the greater portion was, as usual, of really good quality.

The other area of Sudanese cotton production dependent on inundation is situated at Kassala and in the delta of the river Gash, which is in

PLATE XXXI.



FIG. 101. — Hausas Picking Cotton at Kassala.
(Photo by W. H. HEMMICKY).



FIG. 102. — Transporting Seed Cotton by Camels from the fields.
(Photo by W. H. HEMMICKY).

flood during June, July and August; the area placed under water varies from 80 000 acres to 200 000 acres (32 to 80 thousand hectares) between one season and another. The cotton produced is practically all of the Sakellaridis type. No rain falls later than October, though at Kassala during the inundation of the Gash, there are usually some 40 inches (1000 mm.) of rainfall. The alluvium has formed a soil bed of 10 to 12 feet (3 to 4 metres) in depth, and is composed of rich black clay. For the cotton crop it is sufficient to eradicate the quick growing weeds twice during the period of growth, and no other cultivation is done. If transport difficulties were not so great, much more cotton could be grown in the Kassala province. The whole of the cotton marketed has at present to be carried some 250 miles (400 kilometres) on camels to Suakin or to Port Sudan, and the supply of camels probably limits the available quantity to about 1000 tons in each season. A railway is in process of construction and when completed the conditions may be entirely altered.

The cultivators in Kassala Province and on the Blue Nile are an interesting race and are chiefly Hausas who emigrated from Nigeria. Being of the faith of Islam, these natives were in the habit of undertaking the pilgrimage to Mecca, and their caravans made the journey across Africa, passing through the Sudan on their way from Nigeria to the Arabian coast. The pilgrims were accustomed to halt in the Gash delta, sometimes to grow food crops, sometimes to aid in cotton-picking or in other work. They found the land so fertile and conditions of life so advantageous that they are settling in the Sudan in large numbers. Towns of 7000 or 8000 inhabitants have sprung up adjacent to the cotton lands of Kassala and along the Blue Nile. There is consequently no scarcity of labour. The 1923 crop in the Kassala province has been very satisfactory, yielding about 600 metric tons of lint.

Turning once more to the cotton-growing districts along the Blue Nile, the whole crop, estimated for 1923 at about 1800 tons of lint, is at present produced by irrigation from the pumping stations at Wad-el-Nau, Tayiba and others. The enterprise is under the auspices of the Sudan Plantation Syndicate, and is established on the following basis:

All the crops are pooled; the Sudan Government has provided the land and has equipped the pumping stations, receiving in return 35 % of the gross proceeds of the crops produced. The growers receive 40 %, and the Sudan Plantation Syndicate retains the remaining 25 %. From this latter percentage all payments have to be made for the minor irrigation canals, first ploughings, ginning and storage and general expert supervision.

The primary aim of the Sudan Plantation Syndicate is not direct profit, but the encouragement of cotton production, since the Syndicate consists largely of cotton manufacturers.

About 20 000 acres (8000 hectares) of the Gezira plain are now under irrigation from this system of pumping stations; of this about 10 000 acres (4000 hectares) bore cotton in 1923. The growers each hold, as tenants of the Syndicate, allotments ranging from 50 to 100 acres (20 to 40 hectares). All areas are applied for and occupied as soon as available.

[...]

A considerable proportion of the holders are Hausas, as in the Kassala district.

In the Sudan, planting begins as a rule in July, the chief exception being the Gash and Baraka deltas, where it is of necessity delayed until the subsidence of the June to August floods. In these two areas planting is carried on during September.

Picking starts in December, continuing until February in some of the rain-cultivation areas and in Berber and Dongola. On the Gezira plain, picking begins in February, as is the case too in the Gash Delta. At Tokar it is delayed until March, and in some seasons picking is not complete until June. The Commercial Intelligence Branch Report of May, 1923, contains the following statement relative to the Tokar (Red Sea) district: "Although large tracts in the Delta have ceased to yield; there are some considerable patches of late-sown cotton which should yield up to about 20 June".

From the above details it follows that cotton is mainly a winter crop in the Sudan, and differs from Egypt in that respect. It is also evident that cotton-growing in one or another part of this immense country is almost always in hand throughout the whole year.

The descriptions of cotton usually planted in the Sudan are the Sakellaridis, — so favourably known in Lower Egypt —, and the Achmouni, which is largely cultivated in Upper Egypt. Of the Sudanese crop grown in 1922, about 46 % was from Sakellaridis seed, and about 44 % of Achmouni origin.

Some localities have been found to suit American Upland varieties, and about 10 % of the 1922 crop was of this species. Where the American Upland plant has become acclimatized, the yield is greater than that of Sakellaridis, sometimes twice as large.

The pink boll-worm (*Platyedra* [*Pectinophora*, *Gelechia*] *gossypiella*) is, so far, unknown in the cotton plantations of the Sudan, and strict precautions are enforced against its introduction from Egypt, where it has been so very detrimental. The pest which has recently done serious injury in the Sudan is that known as *Thrips*, which destroys the vitality of the leaves and stalks, and was especially noticeable in the district of Hosh on the Blue Nile in the cotton crop of 1923. It was estimated that the yield has been reduced locally by 25 % from this cause. Aphides are occasionally present in great numbers, and "assal" was a cause of considerable anxiety at Tokar (Red Sea Province) during April, when cotton was coming to maturity continuously. The damage was, however, not serious as there was a return of favourable weather and consequent acceleration of ripening.

No statement as to cotton-growing in the Sudan would be complete without reference to the plans for future development. These plans conform in their origin entirely to the possibilities of water-supply. It is fortunate that engineering enterprise is available for coping with the many difficulties inherent in the undertakings. The main scheme is that of fertilizing a part of the Gezira plain by means of irrigation. This territory lies between the Blue and the White Nile, its surface forming an

immense triangle just to the South of Khartoum, with an area of about 3 million acres (1 200 000 hectares). To all appearance it is a level plain; in reality there is a slight slope from the eastward boundary by the Blue Nile, to the western limit on the White Nile, a fact rendering irrigation canals quite practicable by utilizing the Blue Nile stream. The Sudan Government, with the assent and guarantee of the British Government, has raised a large loan to meet the cost of a Blue Nile barrage at Makwar, a point situated above the existing pumping stations on the banks of the river mentioned. The barrage is well advanced in construction, and is expected to be complete in 1925. Subsidiary works of enormous extent include about 850 miles (1300 kilometres) of canals, including one main artery of 100 miles (160 kilometres) in length with a width of 20 feet (6 metres) and depth of 6 to 7 feet (2 metres). Mr. HIMBURY compares the whole scheme to the work of the Panama Canal. It will irrigate 100,000 acres (40,000 hectares) of land, and should be equal to greater activities, but the Egyptian Government is at present nervous about water-supply for the cotton crops of Egypt, and has requested the Sudan authorities to limit their drafts on the Blue Nile Stream to watering these 100,000 acres (40,000 hectares). Mr. HIMBURY mentions this as a "difficulty which is not without the possibility of solution by finding additional water elsewhere and at no very great capital expenditure for works". The completion of the Makwar barrage will result in superseding the pumping stations at Tayiba, Hosh and Wad-el-Nou, as, with the canal from the barrage, the whole irrigation system along the Blue Nile will be served without the present expenditure of power involved in pumping, during the low-Nile season, to an elevation of 50 to 70 feet (15 to 20 metres). Mr. HIMBURY remarks that these pumping stations have fulfilled an exceedingly useful purpose, as they have been the means of testing the capabilities of the land for production of good cotton under irrigation, between July and February, a period when the water is not required for Egypt. They have further assisted in training native growers in methods of cultivation, and Europeans in their duties of supervision.

The future development of the Gash Delta is dependent on the railway, which may be ready for transporting the cotton crop early in 1925. Within a short space of time this region might eventually produce 20,000 tons of lint, as some method of conserving flood water might be put into practice. The Kassala railway, too, will render accessible some new cotton areas, where water is equally plentiful; the mountain ranges of Abyssinia give rise to other rivers debouching into the plains.

Mr. HIMBURY has generously allowed the compiler of this article to quote freely from his Report to the Empire Cotton Growing Corporation on the capabilities of the Sudan, and has further placed at his disposal some interesting photographs.

Mr. HIMBURY's settled conviction is, that the Sudan has within its boundaries, the climate, the soil and the water to produce at no very distant date, a crop of cotton equal in quantity and quality to that grown in Egypt, which now produces about 220 000 tons annually.

THE BELGIAN CONGO.

VI-IX. — The districts where cotton is grown have been selected in conformity with climate and soil conditions, taking into account the density of population; cultivation is entirely a native industry and is located in the immediate vicinity of the villages. It thrives chiefly in the following districts:

a) Southward of the equator, in Sankuru and Kasai, Lomani, and Maniema.

b) North of the equator, on the Uelé river (upper and lower). The rainy season is completely different in a) and b); planting in the South takes place in December and January, in the North during June and July. Picking begins in the South in June and is completed by October; in the North it lasts from December till April. Consequently cotton is growing throughout the whole year in the Belgian Congo. Agricultural inspectors act as seed distributors, select suitable ground for cropping, arrange dates of sowing, and advise the natives throughout the progress and picking of the crop. All seed for sowing is distributed or approved by the State authorities; the destruction of all cotton plants after picking is over is strictly enjoined. The Government fixes minimum prices to be paid to natives. No purchases of cotton, except by machine ginneries, are permitted elsewhere than at the markets in localities and on dates fixed by the District Commissioner.

La Compagnie Colonnière Congolaise was originated by the Belgian Colonial Ministry, and constituted in March 1920 with a capital subscribed by financiers and textile manufacturers in Belgium. The Colonial Government transferred to the company the two steam ginneries then under construction at Lusambo and Kibombo, and authorised the continuation of the cotton culture commenced by the State on an experimental basis in 1916.

The Company defined its aims as follows: a) Cotton buying, b) Cotton ginning, baling, forwarding and selling, c) Experimental work on new varieties of cotton, d) Production of pure cottonseed from the best selected varieties, e) Offering prizes to growers of the finest samples, f) The study of subsidiary industries, such as the manufacture of canvas for baling, and of cottonseed oil, g) Planting and cultivation of cotton and of other products included in the necessary rotation, of crops or in food supply, also transport and shipment.

Five ginneries were in operation in 1922 and two additional establishments were to be installed. An oil press has been constructed at Lusambo.

In the district of Lomani, designated for installation of a ginners, the cotton production in 1922 was only slightly larger than in 1921, as natives found palm oil more profitable. As there was no machine ginners in the district the transport of the seed cotton (one-third lint, two-thirds seed) for long distances was very difficult and costly.

The data on production since 1917 are furnished by the Colonial Ministry at Brussels, the figures are in metric tons; it is probable that those of 1920 and earlier represent unginned cotton, but those of 1921 and 1922

certainly give the quantity of lint remaining after ginning: 270—450—750—900—980—1055 metric tons for the years 1917-18-19-20-21-22, respectively. The management of an experiment farm in Maniema for the selection of cotton varieties on the most approved American plans, has been once more taken up by the State.

The cotton enemies include the pink bollworm, the bollworm or earworm, the cotton stainer and the cotton louse. No information is available as to the relative amount of damage done by these pests.

Exports, practically all to Belgium, were 986 metric tons of lint in 1922.

J. H. H.

602. Kapok : Production and Commercial Value.

I. — GRIST, D. H. Kapok. *Malayan Agricultural Journal*, Vol. X, No. 2, pp. 51-55. 1922, and *Idem*. Vol. XI, No. 1, pp. 1-27. Kuala Lumpur, 1923.

II. — EATON, B. J. and DENNETT, J. H. The Comparative Buoyancy of Malaya and Java Kapok. *Idem*, Vol. X, Nos. 10, 11, 12, pp. 295-300, Kuala Lumpur, 1922.

III. — GEORGI, C. D. V. Kapok Oil. *Idem*, Vol. X, Nos. 11, 12, pp. 284-286. Kuala Lumpur, 1922.

IV. — MATHIEU, E. (Superintendent, Government Plantation, Kuala Kangsar), Kapok (*Eriodendron anfractuosum*). *The Tropical Agriculturist*, Vol. LIX, No. 6, pp. 335-343. Peradeniya, Ceylon, 1922.

V. — WALDOCK, A. P. Notes on Kapok. *Idem*, pp. 343-345. Peradeniya, 1922.

VI. — MOLAGODE, W. (Agricultural Instruction, Central Division). Kapok or Silk Cotton Tree. *Idem*, Vol. LX, No. 2, pp. 122-123. Peradeniya, 1923.

VII. — Indian Kapok Seed (*Bombax malabaricum*) as a Source of Oil. *Bulletin of the Imperial Institute*, Vol. XVIII, No. 3, pp. 335-337. London, 1920.

VIII. — Indian Kapok Seed and Kapok Fibres. *Idem* Vol. XX, No. 1, pp. 28-29 and pp. 31-32. London, 1922.

IX. — SALEEBY, M. M. The Kapok Industry, Revised Edition of *Bulletin* No. 26, Bureau of Agriculture. *Philippine Islands*, pp. 41, plates VIII, Manila, 1923.

X. — Kapok Industry of the Dutch East Indies. *Netherlands Indies Review*, Vol. 3, No. 7, p. 209. Buitenzorg, 1922 (1).

The Kapok tree (*Eriodendron anfractuosum*) is widely distributed throughout the tropics. The demand for kapok has increased considerably in recent years, and the undoubted value of the floss as filling

(1) Other bibliographical references to Kapok: *Netherlands Indies Review*, Vol. 3, No. 7, 1922 (Exports of Netherlands Oil from Java); *Report of Commerce, Industry and Agriculture in the Netherlands East Indies*, 1920; *Literary Digest*, May 6 199 (Harvesting of Kapok in Java); *Nederlandsch-Indisch Landbouw-Syndicaat*. Soerabaia (Kapok Cultuur en Breiding); *The Record of the Board of Commercial Department*, No. 8, pp. 17-21. Bangkok, 1923. (Kapok and possibilities in Siam).

for upholstery and life jackets, combined with the oil value is well known. Reliable information is now available from various sources which should assist the planter to obtain the full benefit from this crop, improve methods of cultivation, to clean and market the floss with comparatively little expense, and without waste and to ascertain further commercial advantages recently reported. Up till now statistics show that the largest supply comes from Java (1), the industry in the Dutch East Indies being well developed (X); Samarang fixes the recognised standards, as the chief exporting centre. The possibilities of extending the industry elsewhere appear extremely practicable.

Cultivation: Soil. — According to the reports from the Federated Malay States (I, IV) deep soil with sandy loam give the best results. GRIST reports that in Java friable loam and weathered volcanic soil, well drained, is the most satisfactory and this is confirmed by SALEEBY (IX) who ranks alluvial soils after volcanic and reports satisfactory results in the Philippines (2), both on sandy and clay loams.

Climate. — Low elevations are preferable (IV and IX) and an altitude below 500 meters is advised (IX), sheltered when possible from strong gales, as the wood is brittle and the tree liable to suffer accordingly.

Propagation and planting. — The idea of growing kapok merely as a secondary crop has changed as this can only be done successfully with crops which do not demand thick shade or wind protection. In the Philippines (I, IX), good results have been obtained with sisal, maguey, hennequin, Mauritius hemp; in Malaya (I) with roselle, sunn hemp, limes and tobacco; in Java (I) with maguey. Interplanting with coconuts is not recommended but kapok may serve as a useful light shade for cacao and pepper (IV).

There has been a certain amount of controversy as regards the comparative advantages of reproduction by cuttings or seed. The general opinion seems to be that the former method is easier and yields sooner (6-12 months earlier) and is commonly employed in Ceylon. In the Philippines, and the Federated Malay States, the seed system, is, however, advisable as the plants are more resistant to wind and white ants. (I, IV, IX). GRIST (I) recommends the "seed to stake method" (3 seeds per hole, thinned to one); MATTHIEU (IV) considers that 9 inches apart *i. e.* 6 lb. per 100 acres is sufficient; SALEEBY (IX) advises shading until 12-15 inches high, some 20-25 days after germination, and transplanting after 10-12 months, early in the rainy season, leaving 20 ft., between: *i. e.* 112 trees per acre. Otherwise the branches are apt to die back owing to mutilation due to overlapping.

After treatment: Little after cultivation is necessary, but if other crops are not grown in conjunction with kapok, 4 ft. clean should be left round the plant during the early stages (I). In Malaya the young trees are treated like rubber *i. e.* topped, leaves stripped and roots trimmed. Co-

(1) The Bureau of Statistics (Int. Inst. of Agric.) reports the exports in 1921 as 17 585 339 kg. for Java, and 7 750 cwts for India (fiscal year 1921-22).

(2) For Kapok industry in the Philippines, see R. 1913, No. 1149. (Ed.)

pious maturing before lifting is important owing to scarcity of laterals. It is generally agreed that 18 ft. \times 18 ft. in suitable spacing, i. e. 132 trees per acre (I, IV).

Diseases and pests: White ants are the chief cause of damage; reference has already been made to the greater resistance of plants propagated from seed in preference to cuttings; keeping the plantations free from timber is also advised. Other pests include:

Dysdercus cingulatus, *Helopeltis* sp., *Batocera hector* and *Alcides leucocent* (I, IX). Diseases are not common, *Corticium salmonicola* and *Ramularia Enodendri* have been reported in Malaya (I). *Loranthus* spp. are the principal plant parasites

Harvest and yield. — The importance of gathering at the proper stage of ripeness is urged; unripe pods will not dehisce if attempt is made first to dry in the sun as the floss adheres too much to the sides. This has been proved in Ceylon (IV). Experiments made in Malaya (IV) with mature and immature pods demonstrate the saving in cost of cleaning and extracting the capsules of the mature pods. When mature the shells become brown with deep wrinkles and begin to open below the peduncle. Extraction should be made at once or semi-pithy material becomes embedded in the final product (IV, V, IX); the proportion in weight, floss to seed is 3 : 5 (IV). It will probably be necessary to make 3 pickings.

The yield is forthcoming from the sixth or seventh year onwards with a gradual increase until about the 20th year (VI). The average crop per tree has been stated as 400 pods which equals 4 lb. clean floss per year — and 1 acre of 109 trees will give about 440 lb. clean kapok (Ceylon reports VI); for 132 trees per acre, 528 lb. (Malaya reports I, IV); confirmed by Philippine reports (IX). Taken generally it may be stated that the yield of seed is double that of floss. The average composition of dry ripe pods is husks and placentas 44 %, seeds 35 % floss 21 % (I).

Cleaning and uses: The invention of cleaning machines is one of the most vital factors affecting the development of the kapok industry. Descriptions are given of the various hand methods employed in the different countries (I, IV, V, IX). The fact that these methods are only effective under close supervision indicates the importance of perfecting the machines. amongst the numerous machines which have made their appearance on the market, one has been reported to give an output of 800 to 1000 kilos of clean kapok per day (Henri JUMELLE) (IV). Various Dutch machines, simple in construction (0.5 to 1 H.P.), are capable of turning out 120 to 200 kilos of floss per day and amongst these, several authors have selected the *Bley* type as one of the best invented. It is claimed to clean about 217 kilos of floss per hour. A detailed description of this machine is given by the *Nederlandsch-Indisch Landbouw-Syndicat*, *Soerabaya*, « Kapok Culture are Bereiding ».

This machine (See I, IX) consist of a horizontal, cylindrical wooden drum with base made of $\frac{1}{2}$ inch mesh wire-netting, through which a square-section steel axle is fitted in self-lubricating bearing with a number of vanes or beaters set spirally on each face of the axle. These are fixed at an angle like the blades of a propeller and by imparting a screwing

motion, draw the kapok through the machine. The last pair of beaters, near the outlet, are set in opposite direction, to avoid choking. Opposite the outlet are two large fan-like blades set in the same plane as the axle which cause an air-blast and remove the cleaned kapok. Iron pins are driven into the sides of the drum.

The BLEY type has been in use on some Batavia estates for many years and appears the most reliable.

Other machines also described as useful are: the BECKER (cleans about 120 kilos of floss per hour (3 H.P.) and the kapok requires no preliminary drying before treatment in the ginner; the LIENAN small scale machine of simple construction, inexpensive to operate and useful for small plantations (cleans about 120-130 kilos per day of 10 hours (1 ½ H.P.). British manufacturers report that these machine are especially constructed to liberate the floss from the seed; the GAJAMPRI machine (vertical drum and axle filled with round, wrought-iron beaters; an air blast blows the cleaned kapok through a wide pipe at the top, and the heavy seeds fall through an opening in the bottom; HK. JONKER en ZOON's machine (Amsterdam), a more complicated construction, 4 H.P., capacity about 600 kg. per day; suitable for large quantities and produces a very fine silky kapok.

Marketing: The size of the bale varies according to the export market; from Java to Europe the size is fixed at capacity 12 cub. ft. containing 90 lb. (IV). The kapok is baled in jute sacking for export to Australia and in matting for Europe. This is preferable to sacking, taking into account the nature of the floss. Hydraulic baling is considered essential for export and the use of handscrew presses for inland transport; the BLEY screw press has been found satisfactory (four sided chamber fitted with two screws one above and below) and also the side screw presses (I).

The Department of agriculture in Kuala Lumpur (F. M. S.) has made special investigations recently on cultivation machinery marketing, supply and demand, prices etc. (I).

Fibre value (I): With reference to the recognised value as filling for upholstery, an interesting comparison has been made between the weight and costs of various forms of stuffing for an average mattress (I).

Kapok	9	kg.	at 3.50 fcs.	per kg.	31.50 fcs.
Seaweed	16	"	" 0.75 "	"	" 12.00 "
Wool (white carded)	10	"	" 3.15 "	"	" 31.50 "
Horse-hair	5.5	"	" 5.15 "	"	" 43.07 "

Recent investigations have been made as to the comparative buoyancy of Malaya and Java kapok for life jackets (I. II) and results indicate that the Malayan samples are only slightly inferior to the latter and are well above the Board of Trade standard viz. — "a life jacket whose buoyancy is derived from kapok must be capable of supporting at least 20 lb. of

(1) WALDOCK (V) draws attention to a similar product, the value of which is not known, viz. the product of *Calotropis gigantea* and *C. procera*. This shrubs grows wild in Ceylon and gives a silky and long staple fibre which probably has a distinct commercial value.

iron after floating in water for 24 hrs. with a 15 lb. iron weight attached". As regards suitability for spinning purposes, various tests have been made in Germany etc. and reports have been received from the Director of Economic Services in Indo-China concerning the native industry. It appears that the fabric is unsuited for making garments but is of considerable value for linings of overcoats.

The value as a filler for surgical dressing has hitherto not been fully appreciated (1), for this purpose it possesses the requisite advantages of lightness, elasticity, dryness and adaptability to dry sterilisation.

Oil value: (III). — Experiments made in Malaya show that Kapok seed constitutes a valuable bye-product containing rather more than 20 % of oil, easily extracted and decorticated in which case the oil content of the kernel amounts to about 40 %; the cake is rich in albuminoids, 4 % nitrogen corresponding to 25 % albuminoids.

The Indian Kapok (Bombax malabaricum) (VII, VIII) (2). — This species is found throughout India and Ceylon. Unlike the *Eriodendron* the floss surrounds the seeds in the capsule and in preparation for market the seeds are separated. Investigations have been made at the Imperial Institute (London) to ascertain the commercial value of the fibre and oil. Analyses indicate that compared with the ordinary kapok, the yield of oil is higher and the quality superior; the constants of the two types are similar but the iodine value of the oil of *B. malabaricum* is considerably lower. The residual meal was of more value as a feeding stuff and has a higher nutritive value than undecorticated cotton seed cake:—

	Moisture	Crude protein	Fat	Carbo- hydrate	Fibre	Ash	Nutrient Ratio	Food Units
	%	%	%	%	%	%		
<i>E. anfractuosum</i>	13.80	26.25	7.47	23.19	23.19	6.10	1:1.5	107
<i>B. malabaricum</i>	11.40	36.50	0.80	24.70	19.90	6.70	1:0.7	118
Undecorticated Cotton seed cake	13.75	24.62	6.56	29.28	21.19	4.60	1:1.67	107

It is considered likely that Indian Kapok seed will fetch a price equal to if not higher than that realised by commercial kapok seed viz £15 per ton in November 1920 on the British market.

Investigation as to the suitability of machine-cleaned Indian kapok for use in life jackets have been in progress (1916-1922), and official tests of floss have given satisfactory results.

M. I. Y.

(1) See R. 1919 No. 520. (Ed.)

(2) Another *Bombax* sp. namely *B. buonopozense* var. *Vuilletii*, of probable value has been found in the Sudan. See R. 1920, No. 422. (Ed.)

603. **Coimbatore Sugarcane Seedlings.**

I. Review of Sugar Cane Agricultural Operations in India, 1921-1922. *The International Sugar Journal*, Vol. XXV, No. 293, pp. 242-246, London, 1923.

II. The Exotic Value of Coimbatore Seedlings. *Ibidem*, No. 294, pp. 284-285.

III. CLARKE G., HUSSAIN, MOHD, NAIB, and BANNERJEE, S. C. Coimbatore Sugarcane Seedlings in the United Provinces. *Agricultural Journal of India*, Vol. XVII, No. 5, pp. 445-462, Calcutta, 1922.

IV. Mill Trials of Selected Coimbatore Sugarcane Seedlings. *Ibidem*, Vol. XVIII, No. 3, pp. 249-256, Calcutta, 1923.

The problem of the improvement of the Indian sugar industry is mainly one of increasing the tonnage of cane per acre, as the yield in Hawaii is about 41 tons, Java 40, Cuba 20 and in Northern India only 11 tons per acre. Cane varieties suitable for this district must be very hardy as the cultivator of North India gives his cane indifferent treatment and rarely has capital to expend on fertilisers.

In 1912 the Cane-breeding Station at Coimbatore was sanctioned and the problem of evolving a better type of cane was undertaken by Dr. C. A. BARBER, C. I. E. late Imperial Sugar Cane Expert, whose work is now being continued by his successor, RAO SAHIB T. S. VEN KATRAMAN. The methods in breeding and raising the seedlings are given in detail with excellent illustrations in *Memoirs of the Department of India* (1). It was necessary to supplant the present type of cane by an equally hardy type, but with better juice, shorter growing period and yielding a greater tonnage of cane. An interesting point in the breeding was the introduction of the wild grass *Saccharum*, which was crossed with a tropical cane acclimatised for a century or more in Southern India. After several years' work seedlings were produced having the required characteristics, and these have been practically tested under North Indian conditions at the Shahjahan Sugar Station. These new seedlings are resistant, early maturing and give a large yield of canes with rich juice.

Seedling No. 205 gave 60-80 % higher yield of *gur* per acre than the best local canes in the Punjab but Nos. 210, 213 and 214 are considered to be the most promising. At Pusa No. 213 gave 60 tons per acre of good quality cane and 214 has been selected for extended trial in the United Provinces.

The first mill trial was carried out in December 1922 when over 9 tons of No. 214 were crushed; the results obtained were as under:

This cane (214) ripens much earlier than Hemja and apart from the increased tonnage which it gives, actually yielded 1.5 % more sugar. RAO SAHIB VEN KATRAMAN states that more recent seedlings now undergoing trials are superior in all respects to those already sent out.

(1) *Memoirs of the Department of Agriculture of India, Pusa Studies in Indian Sugar-canes*, by C. A. BARBER, C. I. E. Sc. D. Vol. VII, No. 1, 1915; Vol. VIII, No. 3, 1916; Vol. IX, No. 4, 1918; Vol. X, No. 2 and No. 3, 1919.

Comparative analysis of the first mill juice.

	Co 214 crushed December 5	Hemja (local variety) crushed December 7
Brix	19.30	16.70
Sucrose	15.94	13.54
Purity	82.58	81.08

These new Coimbatore seedling canes should be worth the attention of countries outside the tropics, such as Natal, Southern Queensland and of New South Wales, or even Egypt and Argentina. W. S. G.

604. **Nicotine Content of South African Tobacco (1) and the Value of *Nicotiana rustica*.**

I. — JURITZ, C. F., The Nicotine Content of South African Tobacco. *Journal of the Department of Agriculture, Union of South Africa*, Vol. IV, No. 6, pp. 552-562, bibliography. Pretoria, 1922.

II. — Production of Tobacco suitable for Manufacture of Nicotine. *Idem*. *Annual Report of the Department of Agriculture*. *Idem*, Vol. V, No. 6, p. 503. Pretoria, 1922.

III. — OOSTHUIZEN du P. (Manager Experiment Station, Rustenburg). Tobacco Cultivation for Nicotine: *Nicotiana rustica* Species. *Idem*, Vol. VI, No. 2, pp. 166-175. Pretoria, 1923.

Investigations have been made recently with the heavier and lighter South African tobaccos to ascertain the available percentage of nicotine content. Samples have been collected of various species and from different localities and analytical tests made at the Potchefstroom School of Agriculture in conjunction with cultural experiments at the Rustenburg and Elsenburg Experiment Stations.

The most promising results were obtained with a wild variety *Nicotiana rustica*. The nicotine content was 8.87 % (leaves) and 6.24 % (whole plant) compared with 3 to 5 % of other heavy tobaccos. According to the analyses made by Dr. JURITZ, there is a distinct variation in nicotine content at different stages of growth. There appears to be an increase up to a certain stage and a subsequent diminution as the plant matures. Results compare very favourably with other wild species such as *Nicotiana glauca* (0.18 % nicotine from fresh leaves) and with the ordinary tobacco, *N. Tabacum* (4 %). OOSTHUIZEN reports that *N. rustica* has proved less susceptible to insect pests and diseases and is harder and earlier than the ordinary species. The actual cultural operations are almost identical. A heavy application of farmyard manure and other nitrogenous fertilisers increases both yield and nicotine content. Close planting (12 inches apart in the row) is more effective than 18 inches; a difference of approximately

(1) See R. 1922, No. 1313. (Ed.)

400 lb. per acre has been obtained at Rustenburg although the nicotine content is identical. Topping the plants appears, however, to have an advantageous effect in this respect and also facilitates the harvesting of the plants when most of the leaves are matured. At present the utilisation of the whole plant appears to be the most economical proceeding as the stalk gives about 2 % nicotine. From two to three cuttings can be made in one season if the crop is not allowed to become over ripe.

Green sweating in a cool shed followed by air curing has given the best results from the economic standpoint, although a flue-cured leaf contains the highest percentage of nicotine. The percentage is lower when the whole plant is air-cured than when individual leaves are air-cured. Drying tobacco in the sun considerably reduces the nicotine content.

OOSTHUIZEN reports the results obtained with different manurial treatments and the effect of cutting back and leaving untopped, and the tables show the moisture, nicotine and ash content of the component parts of the plant.

Results of the Experiments at Elsenburg and Rustenburg should encourage the growing of this species of tobacco and it is considered probable that the manufacture of nicotine in South Africa will develop into a profitable undertaking (1).

M. L. Y

Crops.

605. The Quality of Selected and Hybrid Swedish Wheats.

ÅKERMAN Å. Försök och iakttagelser rörande svenska vetesorter Kvabtet. *Tidskrift för Landtman*, No. 13, p. 201-203. Stockholm, 1922.

The object of the selection work begun in 1880 by the Seed Society at Svalöf and its branches was to unite in one type of autumn wheat, in the best possible proportions, the characters of productiveness, strong straw and cold resistance.

The question of the quality of the product was for a long time regarded as being of secondary importance. It is only quite recently, as a result of the special condition of the market induced by the war, and the great increase of grain production in Sweden, that the attention of expert breeders of selected seed has been seriously directed to the improvement of the grain.

Before, however, actual true selection in this direction can be undertaken, it is necessary to determine the real differences between the selected types and the native types and study the nature of these differences in order to obtain some data that will guide the selectionist in his choice of the best methods of surely and rapidly attaining his objects.

(1) Experiments have been made at the Federal Experiment Station, Ephrata, Philadelphia (U. S. A.) with *N. rustica* which confirm the nicotine value of this tobacco; and claim also that the product is very suitable for destruction of insect pests. The dried leaves and stalks are ground to a fine powder and 1 lb. of the powder is sufficient to make 20 gallons of 5 % solution. (*Florists Exchange*, Pa.). (Ed.)

The first difference noticed on comparing Canadian Red Fife wheat with Swedish Pansar is that of the water content, which amounts, respectively to 11-13 % and 15-19 %. Before the grain is ground at the mill, it is first soaked, and then dried till it contains 16 % of water. It can be readily understood that the American wheat with an average water content of 12 % can quickly increase it by 4 %, thus giving a yield 5 % higher than that of the Swedish wheat with an average water content of 17 %.

The great virtue of imported hard wheats is their capacity to absorb and retain a larger amount of water which renders the bread more porous, bulky, and digestible while at the same time improving its appearance.

This property, however, is more advantageous to the baker than to the consumer, who when he buys bread made from American wheat, obtains for equal weight many less calories than from bread made from Swedish wheat. The present mixture which is composed of Swedish flour to which has been added 30 % of flour made from hard wheat seems to satisfy the requirements of bread-making. This mixture absorbs a little less water than pure American flour, gives 450-490 cc. of bread per 100 gm. of flour, and bakes easily and well.

According to the author, the wheat produced in Sweden should contain about 15 % of water. (Pansar 17 %).

We will now examine in detail the qualitative characters of both the old local types and of the selected types and the hybrids. The following table gives a summary of RHODINS observations (1910-1913).

Thus, the native Swedish wheat ranks first, both as regards volume of bread and gluten content. It is closely followed in volume by Bore, Grenardier II and Sol which varieties have, however, a slightly lower gluten content.

In 1920 and 1921, the author carried out a series of bread-making

	Weight per hectolitre		Gluten content		Flour yield		Volume of bread in cc. per 100gm. of flour	
	1910	1913	1910	1913	1910	1913	1910	1913
	kg.	kg.	%	%	%	%		
Remodlad Squarehead. . .	77.6	78.4	12.0	10.6	77.6	77.2	459	452
Extra Squarehead	76.6	76.9	14.5	11.2	77.5	75.4	485	(323)
Grenadier II	78.1	77.6	13.0	9.4	76.8	76.8	(541)	457
Bore.	78.6	77.6	14.1	10.9	78.8	75.8	498	481
Pudel	77.0	77.0	14.0	10.9	75.0	76.3	445	443
Sol	79	81.5	13.1	11.0	77.9	78.2	468	463
Landvete (native)	78.5	80.4	14.9	13.4	78.0	77.8	506	458

tests with the chief varieties of wheat on the market in the United States, and from the Svalöf Station, and the Sub-Station of Östergötland, Uppland, Värmland and Angermanland. The results of these experiments showed that Bore and Thule II were very near native Swedish wheat from the

standpoint of volume. Taking the volume of the latter as 100, we have 98.7 and 97.7 for Bore and Thule respectively. The dough of Bore and Thule is a little less elastic and the bread somewhat less porous than in case of the local native Swedish wheat.

Thule II comes from a cross between Pudel and Sammet (native Swedish), and has inherited the good bread-making qualities of the latter. From the same cross has been obtained the Svea type which is especially suited to the northern districts of Svealand owing to its resistance to cold, and weight per hectolitre. Its bread-making qualities were not satisfactory, so that if the results of the tests are confirmed, it will be necessary to replace this variety with another. This work is, indeed, already in progress at the Sub-Station of Ultuna.

The Birgitta wheat also makes bad bread; its vegetative characters are probably derived from Smaahvede.

The most widely-grown varieties of south Sweden, Pansar II and Sol II, are inferior to Bore and Thule. Reckoning the volume of native bread at 100, we have 94.3 and 96.8 for Pansar and Sol respectively. Excellent results have, on the other hand, been obtained from the Halland March wheat and Extra-Kolben March-wheat. At the present time, the different wheats rank as follows:

- 1) Squarehead and Smaahvede.
- 2) Sol and Pansar.
- 3) Thule and Bore.
- 4) Native Swedish.
- 5) Group of March-wheats, Kolben type, etc.

The best quality of hard American wheat gives a volume of bread 10% larger than that of the native Swedish varieties. In the case of Thule and Bore, however, it is necessary, in order to obtain flour of this strength, to add only 15-20%, instead of 30% of American grain; on the other hand, 30% must be added to Sol and 30-40% to Pansar.

It is very advisable that the work of crossing and selection already begun at Svalöf should be continued with a view to improving the types obtained, especially as regards the requirements of South Sweden.

G. A.

606. Red Fife Wheat.

Report issued by the Incorporated National Associations of British and Irish Millers. London Corn Circular, Year 80, No. 75, pp. 5-6. London, 1923.

The varieties of wheat grown in England, with the exception of the new one, Yeoman, are not suitable for the commercial production of bread without the addition of imported wheat. If home-grown varieties can be produced that are satisfactory to the farmer, miller and baker, the prospects of wheat-growing in England may be revolutionised.

Red Fife wheat, imported in 1902 from Canada and grown successfully during the past 21 years, yields flour of excellent quality, and has been used by Prof. BIFFEN in the evolution of new varieties.

The appearance of a wheat is not a correct index of its quality, nor is the percentage of dry gluten a correct index of a flour's strength, as

determined by baking trials. By the term "strength" is implied the capacity of a flour to yield large, shapely loaves.

The principal conclusion drawn by Messrs. A. E. HUMPHRIES and R. HUTCHINSON from a series of tests made on Red Fife wheat grown at eleven different places in England are :—

- a) That after 21 years of continuous production in England Red Fife retains its distinguishing characteristics.
- b) When grown in some environments its strength, judged by appearance, seems to have diminished, but baking tests show that even in those cases, it retains its distinctive characteristics.
- c) That whereas flour from ordinary English wheat cannot be subjected to long processes of baking, the Red Fife grown for 21 years in England, behaves in this respect quite as satisfactorily as No. 1 Northern Manitoba.
- d) That its characteristics are not substantially affected even if the wheat contains soon, after harvest, from 18 to 21 % of water, but remains free from sprouted grains.
- e) The differences in gluten content are not correlated to the differences in the volume of the loaf.
- f) That Red Fife almost invariably yields in panary fermentation an insufficient quantity of gas, unless some form of yeast food is used.

W. S. G.

607. Experiments on the Green Manuring of Rice (1).

SOMERS TAYLOR, C. (Agricultural Chemist, Government of Bihar and Orissa) and GHOSHI, M. (Professor of Chemistry and Physics, Sabour Agricultural College). *Agricultural Journal of India*, Vol. XVIII, Pt. II, pp.104-114, tables 6. Calcutta and London 1923.

A series of experiments were made at the Sabour Agricultural College to ascertain the value of phosphatic fertilisers combined with green manure for paddy. The following scheme was adopted based on the successful results obtained by the use of superphosphate on the leguminous crop grow: 1) Control; 2) green manure only; 3) green-manure and apatite 3.9 maunds per acre (1 md = 82 lb.); 4) green manure and superphosphate, about 2 cwt. 20 lb. per acre; 5) superphosphate at same rate; half applied at time of sowing the green crop and half at time of puddling soil for transplantation of paddy; 6) basic superphosphate, same rate and treatment; 7) superphosphate alone; 8) basic superphosphate alone.

The results demonstrate clearly that there is no economic advantage in the use of phosphatic manures alone but that applied in conjunction with green manure, marked results were obtained. Working on this basis, further experiments are reported 1919-22 showing the increase in weight of the valuable green crop "dhaincha" (*Sesbania aculeata*) as a result of this combined treatment. For example, green manure only — weight in lb. per acre, 1040; + 1 cwt. bone meal, 4575 lb. + 3 cwt. +

(1) See *R.* April 1921, No. 383. (Ed.)

super 6862 lb. Experiments made in other districts confirmed these results. The paddy is transplanted when about 2-6 inches high and should give a yield of about 2-3 tons per acre.

These experiments refer to poor sandy soil containing only 0.036 % total phosphoric acid and 0.44 % lime.

In consideration of the recognised function of the leguminous crop, to supply nitrogen, further experiments were made to ascertain the actual amount of nitrogen which it is possible to supply to sand by the use of the green manure *Sesbania aculeata*. Plants were grown in sterile nitrogen-free sand and determinations were made at different stages of growth. Results showed that in 17 days, the quantity of nitrogen fixed per plant was 3 times that contained in the seed and in 50 days this was about 150-200 times higher. Estimating 1 plant per foot square and 43 560 plants per acre, the amount of nitrogen added to the soil by *S. aculeata* would be: for 0-20 days, 196 gm.; for 40-50 days, 2 702 gm.; for 50-60 days 7654 gm.; for 60-70 days, 13 434 gm.; for 70-80 days, 21 862 gm. With, a 6-inch spacing, from plants 50-60 days old, it is estimated that 177 664 gm. of dry matter or 588 320 gm. green matter and 30 616 gm. of nitrogen may be obtained per acre. The vigour of the plants and the rapidity of growth also determine the amount of nitrogen fixed; the greatest amount fixed per unit of dry matter was at the ages between 6 to 8 weeks. The percentage of nitrogen in the plants appeared to increase with age; at 50-60 days, 0.039 gm. per plant; at 60-70 days, 1.80 gm. The amount of dry matter remained nearly constant at 11-12 % of the total green weight until the plants were about 50 days old; this was followed by a sudden rise and then remained stationary at nearly 25 % until the flowering period.

M. L. Y.

608. The Effect of Root Excretion of common Paddy Weeds upon Crop Production of Lowland Rice.

DE PERALTA P. and ESTIOKO P. R. *The Philippine Agriculturist*, Vol. XI, No. 7, pp. 205-216, tables 3, bibliography. Los Baños (Laguna), 1923.

Experiments were made by the authors in 1922 at the College of Agriculture, Los Baños (Laguna) with a view to substantiate the theory hitherto put forward *i. e.* that the main cause of low yields obtained through inadequate crop rotation may be attributed to the excreta of growing roots, when the aqueous extract of soil from fields where certain weeds are abundant, is applied to another crop. A lowland variety of rice was selected for study and cultures of common weeds in paddy fields, zacate (*Leersia hexandra*), water lily (*Monochoria hastata*), sedges (*Cyperus* sp.) and rice (*Oryza sativa*) were prepared as follows:—

The water from the upper set of cultures (weeds) made in quadruplicate form in 5 sets of cans, is directed into a lower set of cans containing rice cultures. Each can contains 18 kg. of well pulverised clay loam.

The results obtained show conclusively that *Cyperus* spp. and water lily excrete substances beneficial to rice production and zacate excretions have a detrimental effect.

If therefore, these two common paddy weeds are grown in rotation with rice, an increase in production may be expected; and the contrary applies to zacate. It appears also that rice excretes a deleterious substance causing a reduction of 9% in grain yield replanted in the same field. The authors consequently recommend thorough ploughing and harrowing before planting to ensure elimination of the toxic substances.

M. L. Y.

609. **The Effect of Potassium and Magnesium upon the Quantity and Quality of the Potato Crop.**

MARHOLT, D. Untersuchungen über die Wirkung des Kaliums und des Magnesium auf Menge und Güte der Kartoffelerträge. *Die Landwirtschaftlichen Versuchstationen*, Vol. C., Part 6, pp. 315-340, bibliography. Berlin, 1923.

The author gives a summary of the literature (dating from the time of Liebig), that deals with the effect of magnesium upon plants, and then passes on to describe his own experiments made during the three-year period 1917-1919, in the field belonging to the Chemical Laboratory of Giessen (Germany), on an alluvial clay of great water retaining capacity. The objects of the experiments were to determine how far the quantity and quality of the crop were influenced by: 1) various magnesian salts; 2) the separate introduction of the chloride, sulphate and carbonate of magnesium into a complete fertiliser; 3) the application of the salts combined with green manuring such as hop clover (*Trifolium procumbens*) 2); fertilisers like those mentioned in 2 and 3 supplemented with stable-manure.

The mineral fertiliser was composed of: sulphate of ammonia (60 kg. nitrogen per hectare); basic slag (110 kg. of phosphoric acid per hectare); potassic and magnesian salts (100 kg. of oxide of potassium, or magnesium, per hectare). The stable manure was applied at the rate of about 400 quintals per hectare.

The results obtained show that:

- 1) The salts of magnesium present in the soil have no favourable effect upon potatoes; the salts containing chloride of magnesium decrease, as compared with a complete fertiliser, the starch content of the tubers.
- 2) In fertilisers that do not include substances forming humus, magnesian salts have very little effect upon the potato crop. In many cases, the application of sulphate of potassium alone produces as large, or almost as large crops as are obtained with potassic salts + magnesian salts. Sulphate of magnesium sometimes increases the yield; the carbonate and chloride are both less effectual.

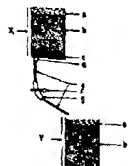


FIG. 103. — Showing method of obtaining the drainage from two cultures.

x = Upper culture (weeds)
y = Lower culture (rice)
a = water c = glass-tube
b = soil f = pinch cock
c = gravel g = rubber tube
d = rubber stopper

3) The effect of a complete mineral fertiliser is greatly increased by the addition of organic manure. Green-manuring with hop clover considerably intensifies the favourable effect of a potassic-magnesian fertiliser, when the latter is applied in the form of a sulphate. The absolute starch yield generally increases with the potato crop, but the starch content of the tubers is decreased by the green manure, especially if this is applied at the same time as a complete mineral fertiliser (nitrogen, potassium, sulphur). The percentage of starch in the potatoes is, on the other hand, slightly increased if sulphate of magnesium is also introduced. This percentage was 21.06 in the unfertilised plots; 19.52 in those receiving only green manure; 18.80 in plots with green manure + nitrogen + potassium (sulphate); 19.12 in plots with green manure + nitrogen + phosphorus + sulphate of potassium and of magnesium. On the other hand, the absolute amounts of starch in quintals per hectare were respectively: 6.76 — 7.10 — 33.22 — 35.04, and the yield of tubers was respectively: 32.1 — 36.38 — 176.70 — 183.28 quintals per hectare.

4) The application of stable-manure increases the good effects of mineral fertiliser still more than green-manure. A complete mineral fertiliser added to stable-manure produces a crop of tubers 20 to 40 % higher than can be obtained when green manure is added to the organic manure, and 50 % higher if it includes the sulphates of potassium and magnesium. The effect of stable-manure upon the starch content of the tubers is similar to that of green manure.

The use of sulphate of magnesium as a fertiliser for potatoes is only to be advised when it is added to stable-manure applied at the same time as a complete mineral fertiliser.

F. D.

610. The Cultivation of the Sweet Potato in Java.

CRAMER, P. P. S. (Director of the General Station and of the Experiments Station of the Department of Agriculture at Buitenzorg, Java). *Revue de Botanique appliquée et d'Agriculture Coloniale*, Year 3, Bulletin No. 20, pp. 233-241. Paris, 1923.

In the Dutch Indies, the sweet potato (*Ipomoea Batatas* Poir), occupies the fourth place in the series of food crops, the other three being rice, maize and manioc. The sweet potato is chiefly grown in Java as a dry season crop; it occupied 179 000 hectares in 1916, and 267 000 hectares in 1920.

The following is the composition of the tubers as grown in Java: water 70 to 86 %; starch 8.22 % glucose 1.5 to 4 %. Most of the crop is used for human consumption, while a certain amount is fed to pigs. Formerly, sweet-potatoes were grown on the rubber plantations, but this practice had the disadvantage of attracting wild boars. As the tubers can produce 3250 to 3860 kg. of starch per hectare in four months, the sweet potato forms a cheaper source of starch than manioc, a plant that occupies the ground for a much longer time. Sweet-potatoes are planted on loose soil in a well-prepared bed. Generally, 36 000 are planted per hectare. All that is necessary is to hoe them once, or twice, and keep the bed in good condition.

The plants are propagated from the stems, the upper portions cut into pieces, one foot in length being used by preference. In America, rooted slips obtained by putting the tubers on a layer of sand under a frame are chiefly used in order to shorten the vegetative period. Shoots develop from the eyes and are pulled out of the soil, the tuber being held in its place during this process. This method is to be recommended for introducing new varieties.

An average crop of 12 000 kg. per hectare removes from the soil 35 kg. nitrogen, 14.5 kg. phosphoric acid and 72 kg. of potash. Experiments made in Java have shown that sulphate of ammonia is especially effective in increasing the yield; potash appeared to have no fertilising power. The introduction of a green manure into the rotation seems to be the best method of fertilising. Great care must be taken in the application of a fertiliser, for an excessive supply of nutritive substances may cause the plant to develop stems and leaves at the expense of the tubers. Thus, at Buitenzorg, the "Oebi Krantil" variety produced on the less fertile parts of the rice-fields 25 200 kg. of stems and leaves and 8400 kg. of tubers, while on the richer plots, it bore 54 600 kg. stems and leaves and only 900 kg. of tubers. In the case of the "Onglay" variety, the figures were respectively 16 200 kg. (leaves and stems) and 14 200 kg. (tubers) on the one hand, and 44 800 kg. and 5 500 kg. on the other.

The crop is lifted 4 months after planting. M. VAN SETTEN has observed the following progression in the yields (Tjina variety) — 3 months: 1 200 kg., 4 months: 14 700 kg.; 5 months: 16 800 kg.; 6 months: 10 800 kg. The tubers when taken out of the ground must be dried in the sun and carefully handled. The only enemy of the sweet potato is a beetle: *Cylas turcipennis* (known in other countries as *C. formicarius*). The sole means of combating this pest is by a rotation of crops, rice, being the best for the purpose, and by not leaving the tubers long in the ground.

The net cost of sweet potatoes is 1.60 dollar per 100 kg. in the United States, but in Java, the native grown crops can be produced for less than half this amount. The sale-prices in the two countries are in the same proportion. The different varieties of the sweet potato vary greatly in flavour owing to the fact that in Java these tubers are never eaten by the white man, whereas in United States, they are even more appreciated than the ordinary potato. The Division for the Selection of Annual Plants at Buitenzorg, under the Management of M. KOCK, has produced a number of new kinds of sweet-potato which are supplied on application.

R. D.

611. Seed Mixtures for Grasslands.

STAPLEDON, R. G. (Welsh Plant Breeding Station, Aberystwyth). *Journal of the Ministry of Agriculture*, Vol. XXX, No. 2, pp. 130-142. London, May 1923.

The author draws attention to the economic importance of selection of strain rather than depending only on species. This applies especially to white clover; the commercial Dutch should only be used on grassland

reserved for two years for sheep grazing but wild white clover can be substituted on short duration grassland as it tends rapidly to form a dense sward. The respective values of early and late red clovers, and imported cocksfoot are also indicated.

As regards the question of *complex* or *simple* seed mixtures, the author refers to three distinct objections to the former, viz. too much competition between the species, unsuitability of certain included species to particular conditions, and different requirements for germination. This points to the necessity for careful choice of mixtures.

Seed mixtures may be classified as follows: a) Stubble; b) one-year ley; c) two-year ley; d) three-year or upwards including permanent pasture.

Insufficient use is often made of stubbles. In Wales a plan has been adopted of sowing seeds with the cereals, solely for the purpose of providing autumn and winter keep until ploughing is begun. Quick growing red clover and Italian rye grass (1) have given the best results (13 lb. per acre is recommended, sown directly after the cereal and harrowed in at the same time).

The following standard mixtures give an idea of the seeding rates which are generally adopted:

One-Year ley: a) for every heavy single hay crop:— Perennial rye grass (2) 14 lb. + late flowering red-clover 4 to 6 lb. + alsike clover (3) 1 to 2 lb.; b) for stubble grazing and aftermath as for hay:— Italian rye grass, 14 lb. + broad red clover 4-6 lb. + alsike, 1-2 lb.; c) general purposes:— Italian rye grass 6 lb. + perennial rye grass 10 lb. + late flowering red clover 2-3 lb. + broad red clover 2-3 lb. + alsike, 1 lb.; d) for conditions unfavourable to the rye grasses but very favourable to timothy grass: timothy 10 lb. + alsike 6 lb. or timothy 10 lb. + late flowering red clover 4 lb. + alsike 2 lb.

Two-Year ley: a) for soils where perennial rye grass is known to hold well into the second year: perennial rye grass 14 lb. + late flowering red clover 4-6 lb. + alsike, 1-2 lb. + wild white clover $\frac{1}{4}$ to $\frac{1}{2}$ lb.; b) for soils where cocksfoot contributes in the second year to a larger extent than the perennial rye grass: cocksfoot (4) 10 lb. + timothy 4 lb. + late flowering red clover 4-6 lb. + alsike 1-2 lb. + wild white clover $\frac{1}{4}$ to $\frac{1}{2}$ lb. or in proportions of 8 lb. + 8 lb. + 3 lb. + 4-6 lb. + 1-2 lb. + $\frac{1}{4}$ to $\frac{1}{2}$ lb. respectively; c) for soils especially adapted to timothy: timothy 10-12 lb. + alsike 4-4 lb. + wild white clover $\frac{1}{4}$ to $\frac{1}{2}$ lb. (As timothy flowers so much later than other grasses, a combination of rye grass is not here recommended). The above mixture is an exceptionally cheap one; d) where it is necessary to rely chiefly on tall oat grass: Tall oat grass 16 lb. + late flowering red clover 4 lb. + alsike 1-2 lb. + wild white clover $\frac{1}{4}$ to $\frac{1}{2}$ lb., or the same mixture, but with 8 lb. perennial rye grass and 8 lb. tall oat grass.

(1) *Lolium italicum*.

(2) *Lolium perenne*.

(3) *Trifolium hybridum*.

(4) *Dactylis glomerata*. (Ed.)

Long duration leys and permanent grass: — a) *for hay and pasture*: — a simple mixture for a three-year old ley is given as follows: perennial rye grass 16 lb. + cocksfoot (New Zealand) 10 lb. + timothy (Scotch), 4 lb. + late flowering red clover 4 lb. + trefoil 1 lb. + wild white clover 1 ½ lb. Where, however, trefoil is not forthcoming (under conditions of high rainfall and on now calcareous soils) the following is considered a "sensible mixture": — perennial rye grass 12 lb. + cocksfoot (New Zealand) 8 lb. + timothy 4 lb. + late flowering red clover (Welsh) 4 lb. + alsike 1-1 ½ + lb. wild white clover ¼ to ½ lb.

b) *for grazing only*: perennial rye grass 10-12 lb. + wild white clover 2-4 lb. (sown under about 2 lb. of rape per acre or without any covering crop). Mixtures including coarser grasses such as rough stalked meadow grass (1) may also prove advantageous.

In each case these mixtures would be most applicable to regions of high rainfall, and if intended for use for winter and early spring grazing the addition of a small quantity of cocksfoot, and timothy might perhaps serve a useful purpose.

M. L. Y.

612. Composition and Feeding Value of some South African Grasses.

TAYLOR, A. J. (School of Agriculture. Cedara, Natal). *The South African Journal of Science*, Vol. XIX, pp. 218-232, tables 4, bibliography. Johannesburg, Dec. 1922.

A considerable number of analyses of South African grasses have hitherto been recorded, but until recently very little systematic work has been done in this direction. During 1921-22 samples were collected at monthly intervals as far as possible at the same stages of growth, in order to study seasonal variations, and analyses made at the Cedara Experiment Farm (Natal). The results are calculated on the dry sample, and tables are given with full details as to the percentage composition and classification of grasses according to percentages of crude fibre, the calorific value and the protein content.

The plants examined are classified into 4 main groups:—

1) Commonly found on waste lands: viz. *Cynodon dactylon*, *Digitaria sanguinalis*, *Eleusine* spp., *Panicum* spp., *Setaria* spp.;

2) Veld or meadow species: viz. *Anthistiria imberbis*, *Andropogon amplexans*, *A. cerasiaeformis*, *Axonopus semialatus* var. *ecklonii*, *Cyperus esculentus*, *Digitaria diagonalis*, *D. horizontalis*, *D. tricholaenoides*, *Eragrostis brizoides*, *E. chalcantha*, *Harpechloa capensis*, *Microchloa cafra*, *Panicum ecklonii*, *P. serratum*, *Tricholaena rosea*, *Tristachya leucothrix*;

3) Coarse grasses: *Andropogon hirtus*, *A. nardus*, *Aristida junceaformis*, *Eragrostis* spp., *Sporobolus indicus*, *Trachypogon polymorphus*;

4) On moist soils: 3 *Leersia hexandra*, *Rottboellia compressa* var. *fasciculata*.

With reference to the percentages of protein both crude and pure respectively, the following species are out-standing: *Cynodon dactylon*,

(1) *Poa trivialis*. (Ed.)

15.3 % and 11.9 %; *Digitaria sanguinalis* 15.3 % and 12.1 %; *Panicum proliferum* 13.2 % and 9.5 %; *Eleusine indica*, 12.9 % and 9.5 %. *Leersia hexandra* 10.4 % and 9 %; *Axonopus semialatus*, 10.3 % and 8.8 %, and other *Panicum* spp. are not far behind.

With reference to percentage of crude fibre, the highest is attributed to *Trachypogon polymorphus* 42.5 %; *Digitaria diagonalis*, 42.4 % and *Aristida junciformis* 41.2 % etc. and the lowest, *Cyperus esculentus* 25.1 % and *Cynodon dactylon* 28.5 %. The calorific value may be judged accordingly; full data are given for all the plants examined. *C. esculentus* possesses the highest fuel value.

As regards seasonal variation, as a general rule the fibre increases and the protein decreases as the season advances. Interesting ecological observations are made by the author relative to the different groups and the effect of environment on the nutritive value and fibre content e. g. *Rotboellia compressa*, transplanted from its original moist habitat to a well-drained hillside soil, flourished under new conditions, matured earlier and the protein content was nearly doubled and of consequent value as a stock feed. Apart from these variations, the grasses on waste lands (Group I), may as a whole be considered to possess a higher feeding value than the ordinary veld grasses (II) and the coarser and inferior grasses in Groups III and IV. The principal veld grass from the stock farmer's point of view is *Anihisteria imberbis* (= *Themeda triandra*).

Results of further experiments made to ascertain the phosphate content of the ash of veld grasses to the deficiency of which is attributed many of the cattle diseases in South Africa, indicate that the average for veld grass is about 0.2 % of dry matter. For grasses on waste, and the amount is about 0.3-0.4 %, but is variable.

M. L. V.

613. Cotton Grafted on Mulberry Tree.

The Field Illustrated, Vol. XXXIII, No. 10, p. 32. New York, 1923.

Nine-hundred bolls of cotton were grown on a plant grafted to a root of a mulberry tree in La Marque (Texas) by DAN GEORGE and have given exceptional results. The new cotton produced 15 lb. seed cotton on 3 mother-plants, or at the rate of 4 bales per acre. The plant breeder is perfecting this new variety on a field scale. This season, certain plants are reported to be nearly 8 ft high, and one has 917 bolls, although the cotton season has hardly begun. The staple measures 1-1 1/2 inches and is of good quality.

M. L. V.

614. Improvement of *Phormium tenax* for the Fibre Industry.

SMERLE, G. *New Zealand Journal of Agriculture*, Vol. XXVI, No. 6, pp. 363-370, figs. 4. Wellington, 1923.

The author was appointed in 1922 by the New Zealand Flax-Millers' Association to carry out investigations at Miranani of the so-called yellow leaf disease of *Phormium tenax*, to breed plants immune to the disease.

PLATE XXXII.

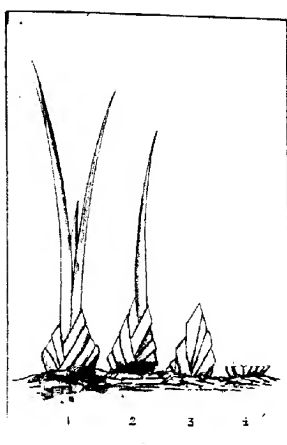


FIG. 104. — Methods of cutting *Phormium*.

- 1 -- Side leaves cut, with 2 mid leaves and centre shoot left intact
- 2 -- fan cut diamond shape with centre leaf left.
- 3 -- cut diamond shape.
- 4 -- common method-whole fan cut level.



FIG. 105. — Seeds of *Afzelia Erieyi* De Wild.

and to improve the methods at present employed in the cultivation and harvesting of the plant.

The factors studied were: 1) the common method of cutting the leaves; 2) grazing of cattle; 3) weed growth.

Improved methods of cutting: Different methods of cutting the plant were tested and compared with that usually employed, viz., cutting all the leaves off parallel with the ground, which is very detrimental to subsequent growth. The methods compared by the author are shown in the figure. (See fig. 104).

Weed growth: Weeds deprive the plant of light and air and add to the cost of cutting the leaf. Plants growing in the open gave 16% fibre, whereas those in the shade produced 12% only.

Selection and breeding: More than 20 varieties or types were grown, and particulars of the yield of fibre and resistance to disease are set out in a table; the yield of finished fibre varied from 2.5% to 18.8%.

Assuming that a certain area yields 100 tons of fibre every 4 years under the present method of cutting, the author estimates that with improved varieties of plants, better methods of cutting and cultivation the yield should be as follows:

Condition of area	Yield by present method of cutting	Yield by side-leaf cutting
	Tons	Tons
Average <i>Phormium</i> area	100	300
Area free from weeds	120	360
Area planted with best varieties and kept free from weeds	180	540

W. S. G.

615. The "Khua-piat. Textile Plant of Laos (Indo-China).

Bulletin Economique de l'Indo-Chine. Le khua-piat., plante textile du Laos. Year XXV, No. 155, p. 472. Hanoi-Haiphong, 1922.

The "khua-piat" is a climbing plant fairly common in the Province of Saravane (French Laos) often reaching a length of 20-25 m. and arm thickness. It grows wild in the thick forest areas and also in the dense thicket on the mountain spurs on the Bolevans plain, at altitudes between 400 and 500 m. The fibre is collected in the rainy season from June to September.

The natives strip off the fibre from the stems exceeding finger thickness, detaching from the bark the tough underlying layer. Stripping is more difficult than with ramie which is cultivated in the same regions. The natives show a preference however, for "khua-piat" owing to its resistance to rotting in addition to its strong fibre, important qualities in a moist climate. For example, a fishing net made with "khua-piat" lasts three times as long as a ramie net. The fibre is light coloured and

glossy and fairly short staple (0.40 m.), varying with the size of the internodes, where the filaments split when stripping.

As regards nomenclature, it is thought to be a *Pueraria* sp. either *P. Thomsoni* Benth., *P. tonkinensis* Gagnet or *P. Thunbergiana* Benth. (known as "kudzu") (1).

R. D.

616. Oil Plants and Seed Products in Siam.

The Record of the Board of Commercial Development, No. 5, pp. 8-17. Tables 13, Bangkok, 1922.

The report includes a general review of the value of vegetable oils as a whole, followed by data concerning the most important oil seeds produced on a commercial scale in Siam, viz. castor oil, copra, cottonseed, groundnut, sesame, soya. This comprises: area under cultivation, estimated yield, distribution, time and period of ripening, local value, nature of oil, uses, and statistics of exports and imports. Further data is given of the world's production and supply of oil (*Special Agents Series No. 75 and Department of Commerce U. S. A.*, No. 89).

A description is given of the somewhat primitive method of oil extraction employed up to the present in Siam, and the typical oil mill. The percentage of oil in the cake and seed respectively is given as follows: copra 13.8 % and 68.0 %; sesame, 10.5 % and 65.5 % groundnut 4.3 % and 53.2 % (small seed decorticated), castor oil, 5.4 % and 47.5 % (large seed). Owing however, to the crude methods of pressing, the local oils and cakes are of inferior quality and fetch low prices.

Suggestions are made for the establishment of a modern oil-mills employing either the solvent process or the pressing process with efficient disintegrating machines, presses and moulding machines. Two pressings are required to obtain the maximum yield of oil. The working cost of a modern plant should be considerably less than that of the present typical oil-mill in Siam.

It is advised whenever practicable to crush and press seeds *in situ*; the advantage of this has already been proved in other oil producing countries.

M. L. V.

617. Oil Value of *Azalia Brieyi*.

PIERAERTS, J. and L'HEUREUX L. *L'Azalia Brieyi* Wild. *Bulletin Agricole du Congo Belge*, Vol. XIV, No. 1, pp. 191-200. figs. 2. Brussels, 1923.

Amongst other interesting observations made by the "Mission forestière et agricole" in the Belgian Congo, that referring to the leguminous specimen *Azalia Brieyi* deserves special attention. (See fig. 105). The late DE WILDEMAN gave a full description of this evergreen tree, which the authors quote, giving in addition, further details concerning the habits and distribution of this species which closely resembles *A. Zenkeri* Harms, in appearance. The wood, harder than oakwood is suitable for cabinet

(1) See No. 600 of this Review. (Ed.)

making, but the commercial possibilities of the oil of the nuts have hitherto been unexploited; the authors therefore after discussion of the morphological characteristics (illustrated), describe the development of the seeds and the results of analyses. These may be summarised as follows:— Average weight 6.44 gms.; size (average) 3.7×2.3 cm.; moisture 8.23 %; matter soluble in water 1.24 %; crude fat 29.84 %; carbohydrates 50.31 %. The ash contains 26.82 % potash and 14.76 % phosphoric acid.

The oil extracted with petroleum ether has a light brownish yellow colour and the extract made with sulphuric ether, a reddish-yellow tint. Both are, however, identical as regards taste, which is similar to olive oil. The former maintains its original taste for several days and the characteristics of this oil are given as follows:— Specific gravity at 19.5° C. 0.9320; refractive index (at 40° C.) 1.475; acid value 3.2; saponification value 183.8; iodine value 144.0. The absence of cyanogenetic glucosides and alkaloids is noticeable. The solidifying point of the fatty acids is given as 52 to 50.5° C.; iodine value 135.0.

Drying tests were made which indicate that the oil does not remain unaltered for long. The day after records were taken, an increase in weight of 0.49 % was observed. Between the 3rd and 43rd days there was less variation, but following this the increase progressed at the rate of 0.54 % until the end of the experiment. Solidification is due to isomerism and polymerism rather than to oxidation which only plays a secondary part in the reaction.

These preliminary tests show the oil value of the seed and the possibility of its employment for food purposes and also as a lamp oil. The residual meal has an agreeable taste and would supply a useful stock feed. Meal containing 7 = 8 % oil compares favourably with the well-known coconut meal, palm oil residue, etc.

M. L. V.

618. Oil value of *Cyperus esculentus* Tubers.

PIERAERTS J. (Directeur du Service Chimique du Ministère des Colonies de Belgique). Le souchet comestible. *L'Agronomie Coloniale*, Year 9, No. 67, pp. 7-21. Paris, 1923.

The author refers to foregoing investigations made with Cyperaceae tubers and draws attention to the high boric and comparatively high manganese content and the equal proportions of lime and magnesium. According to available information and the detailed analyses made by the author, the oil may be termed of first class commercial value. The saponification value is high, viz. 191.3; iodine value 76.89 %; glycerine 8.82 %. The oil does not congeal and readily withstands low temperatures. The fact that rancidity sets in remarkably slowly is a distinct advantage. The sample tested was exposed for several days to the sun's rays and the acid value remained constant; after 8 months the alteration amounted only to 2.85 (i. e. 1.45 % oleic acid).

The value as a superior quality table oil has been confirmed in several countries, but extended use in soap factories and as a substitute for

olive or almond oil for medicinal purposes should be considered and after the separation of the heavy oils it is suitable for oil cloths, and wool carding, etc. The oil should emulsify easily as it resembles olive oil. The point of inflammability is similar to castor oil (245° C.) which, with its degree of viscosity renders it suitable as a lubricant.

The author considers that this oil is in many respects superior to olives and groundnut oils from the industrial standpoint, provided that extraction is made in a systematic manner and the products utilised to the proper advantage:— 1) edible oils obtained by cold pressure; 2) oil for industrial purposes obtained by hot pressure, followed by extraction with solvents; 3) saccharose obtained from residual meal; 4) starchy residue, a whitish farinaceous material without smell and with an agreeable taste. If well dried at a low temperature this should be useful in many respects.

M. L. Y.

619. Oil Value and Yield of *Camellia* spp.

DEUSS, J. J. B. L'huile grasse des graines de thé. *L'Agronomie Coloniale*, Year 8, No. 66, pp. 161-171, figs. 2, Paris, 1923.

Several attempts have hitherto been made to extract oil from seeds of *Camellia* spp. but until recently little value has been attached to the oil from the commercial standpoint. The author reviews the investigations made by different planters and oil analysts and draws attention to the confusion frequently made with the various species, e. g. between *Camellia sasquanqua* and *C. drupifera* etc. The author, however, studied especially oils from *C. theifera* var. *assamica* and *C. theifera* var. *sinensis* and deals solely with the fatty oil content of the seeds and not with the essential oil obtainable from the freshly fermented leaf. (See ROXBURGH and LOHMANN, in *Vierde Verslag over de onderzoekingen, betreffend op Java geëcultueerde theen*).

The viscid oil in question has neither scent nor taste and is used for cooking and medicinal purposes, and as a lubricant, owing to the absence of free acid; it is sebaceous but not bitter and resembles codliver oil and olive oil. An interesting comparison is made between saponification values of the oils from seeds of China, Japan and Assam teas, viz. 195.5, 188.3 and 194.0 respectively. The residual meal after extraction is white and although fairly viscid it soon acquires a bitter and astringent taste and is therefore unsuitable as a stock feed. The nitrogen content does not exceed 1.58 to 1.92% and never less than 12% crude protein; ash 3.3 to 4% (average 0.58% phosphoric acid).

In China the irritant nature of the residual meal from *C. oleifera* has been used to keep off insect attack and for washing horses.

The system adopted by the natives in Java for oil extraction has its disadvantages. Husking is followed by cold pressure, but this has no effect on the saponin content, and the oil is consequently unsuitable for human nutrition. Heat pressure is therefore advised, although the quantity of saponin in clear oil is according to BOORSMA, negligible. Sun drying is not considered sufficient, but a stove heat of 100-105° C. is preferable, to com-

pletely dry off the moisture. Dried grains can be easily crushed and the saponin eliminated by means of benzine or preferably tetrachloride of carbon. The liquid turns yellow rapidly and under normal conditions will remain thus, resembling olive oil in appearance. Calcium chloride may be employed to finally remove remaining traces of moisture. The average yield of oil is stated to be 42 % dry weight. The author has solidified the oil by means of hydrogen and platinum black (Van Leent method), and obtained a light coloured fat, melting point 35.5 C.; refractive index at 40°C 1.4579; iodine value 41.7; saponification value 175.8.

M. L. V.

620. **Mangrove Species as a Source of Tannin in Madagascar.**

SCHÉLL E. (Président de la Section française de la Société des Chimistes des industries du cuir). Ecorces tannantes de la mangrove de Madagascar. *Bulletin de l'Agence Générale des Colonies*, Year 16, Nos. 186-187, pp. 712-720, 2 tables. Melun, 1923.

A large number of tannin barks of doubtful value have been put on the market and have been wrongly classed as mangrove species. Hence the subsequent depreciation in value of the true mangroves. The author proceeds to describe in detail the various species growing in Madagascar and the analyses of the so-called male and female species; the former has a high tannin content 34-42 % (absorbable) and only 0.3 to 2 % (insoluble). The true tannic value of all the barks examined varied from 73.4 % to 83.6 %. The especial value from the commercial standpoint of *Rhizophora* spp., *Bruguiera* spp., *Ceriops* spp., and *Carapa* (*Xylocarpus*) spp. is emphasized (1). The season at which the bark is stripped appears to have a definite importance in connection with the quality of *Rhizophora* spp. and in Madagascar the reports indicate that the last months of the year are preferable, to ensure rapid and complete drying and avoid danger of mould. Under favourable conditions the tannin obtained thus possesses a good colour suitable for leathers, superior in many respects to artificial tannin extracts. The author considers that a higher value should be attributed to such barks, which in pre-war years were exploited solely for adulteration purposes and later in mixtures which have not proved altogether successful.

M. L. V.

621. **Possibilities and Cost of Growing Hevea in the Belgian Congo.**

LEPLAE, E. (Professeur à l'Université de Louvain, Directeur général de l'agriculture au Ministère des Colonies de Belgique). Le succès de l'hévéa au Congo Belge. *Revue de Botanique appliquée et d'Agriculture Coloniale*, Year 3, No. 20, pp. 247-252. Paris, 1923.

Although climatic conditions in the Belgian Congo are on the whole unfavourable to rubber growing, certain areas are adaptable. Insufficient attention has been given to the fact that even if the yield is limited, it is

(1) This confirms the opinion expressed in Bengal (India). See R. 1922, n° 172. (Ed.)

invariably worth the cost of outlay. The most suitable area in the Congo is situated near the Equator between Lukolela and Stanleyville where the average day temperature is 21° to 31° C in the shade. The rainfall is estimated at 60 to 61 inches, well distributed throughout the year. The dry season occurs about January, but even then five or six showers each month may be expected, often accompanied by a thick morning mist.

The soil is sandy and poor even in the equatorial zone, the alluvial deposits in the Congo being of sand. Clay and fertile soils are rare but this is partially compensated by the extreme cheapness of land and the low rate of wages paid for labour, which is only half as much or even less than that paid in other equatorial region. The rates of pay for white people are also less than in Asia. A labourer's daily wage, food included is stated to be 1 franc (Belgian) in the Upper Congo and this is the maximum in the Equatorial zone.

As regards clearing the ground, economies may be effected as regards the actual felling by arrangement with the native chiefs, by the sale of the timber and by planting catch crops, coffee and other food plants with the exception of manioc being found too exhausting.

For clearing which demands merely felling and burning, the cost is estimated as follows, including only the wages for native labour. The figures therefore show the number of days required to clear 1 hectare and the cost of the labour. The expenses necessary for clearing for coffee cocoa and *Elaeis* palm are also given :

	Grassland pasture	Brushwood	Forest light or medium	Forest heavy or virgine
	<i>Days and Fcs.</i>	<i>Days and Fcs.</i>	<i>Days and Fcs.</i>	<i>Days and Fcs.</i>
Hevea	150	400	600	900 to 1000
Coffee	75	100	300	500
Cacao	75	100	200	400
Elaeis	50	100	200	400

The cost of planting is given as follows :

	Hevea at 7 x 3 m or 476 trees per ha.	Cacao at 4 x 4 m or 625 trees per ha.	Coffee at 3 x 3 m or 1111 trees per ha.	Elaeis at 7 x 7 m or 200 trees per ha.
	<i>Days and Fcs.</i>	<i>Days and Fcs.</i>	<i>Days and Fcs.</i>	<i>Days and Fcs.</i>
Nursery work	20	20	20	20
Holing	24	32	55	10
Filling up	24	32	55	10
Planting	24	32	56	10
Paths and trenches	10	10	10	10
	102	126	196	60

As regards supervision, a white man is essential, and the payment is calculated at 80 to 250 fcs. per hectare per annum. The construction of European dwellings requires 1000 to 2500 one-man working days, with rebuilding after 5 years.

Tapping may be started in the fifth year after planting; in the intervening years the cost of maintenance is estimated at 50 to 60 fcs. per hectare per annum.

R. D.

622. **Rubber Grafting (1).**

MARTIN, A. A., propos de la Greffe de l'Hévea. Les grands producteurs ne seraient que des malades. *Bulletin de l'Association des Planteurs*, Vol. X, No. 506, pp. 83-84. Antwerp, 1923.

On the rubber plantations under the direction of the author, a dozen trees have been reported giving 100 to 125 gm. of dried rubber per day; others gave only 25 gm. and 3 to 5 gm. In every case the trees were 12 years of age, but in the early stage of development had suffered from the attacks of wild boars, and deers and had been stifled by *Musa textilis*.

Tapping was commenced after 2 years. The trees giving the highest yield possessed large latex vessels but with the rest, these were poorly developed. From one tree, only 3 gm. per day were obtained and then unexpectedly the yield amounted to 75 gm. in a few weeks time, without any apparent change outwardly.

A trench 2 m. breadth was dug round the tree, and the roots carefully inspected. At a depth of 1 metre a compact mass of rubber, estimated to weigh about 4 kgm., was found on the tap root, and after removal MARTIN noticed that the root had rotted and was attacked by parasites. The sudden increase in latex yield was due to the control of the pests; the latex vessels were subsequently very well developed. In some months, the tree had a totally different value.

A similar operation was effected for the trees giving a latex yield of 100 to 125 gm. and exactly similar conditions were found; the roots were suffering from rot. Before selection of buds for reproductive purposes, it is therefore advisable to ascertain the cause of high yields and whether these are not the outcome of a morbid condition.

No special remark need be made as regards trees giving 20 to 30 gm. per day, and which have maintained this yield from the outset, as they may be considered to be normal.

R. D.

623. **The Treatment of Budded Hevea Seedlings.**

MILSUM, J. N. *The Malayan Agricultural Journal*, Vol. X, No. 2, pp. 47-50, figs. 8. Kuala Lumpur, 1922.

The propagation of rubber trees by budding was described in a former article (2). The author advises that no budding should be done during the rains as mould may enter the wounds.

(1) See R. No. 2 1923, Nos. 201 and 202. (Ed.)

(2) See R. No. 3 1923, No. 383. (Ed.)

After the bud has become well united with the stock the upper part of the latter should be cut off to within 1 ft. of the dormant bud. The best time to transplant the stump to the field is when the shoot has grown from 1-3 inches long, but before the formation of any leaves. A few months later the portion of the stump above the shoot should be sawn off and the cut surface coated with yellow paraffin wax.

Marcottage. — By this means it is possible to have young trees on their own roots and so avoid any possible effect of the stock. The budded stumps should remain in the nursery for a year after budding. A ring is then cut at the base of the scion and a narrow piece of bark removed to the depth of the cambium after which a bamboo basket is placed round the young marcot and filled with light, rich soil, kept moist by daily watering. In about four months roots will have formed and the young seedling can then be severed at the junction with the stock and planted out in the field.

This system entails extra expense and more time is necessary for the establishment of the trees.

In the case of budded *Hevea* stock, thinning out should not be required and 70 to 80 trees per acre would give a sufficient stand when in bearing.

W. S. G.

624. Results of an Enquiry into the Preparation of Sheet Rubber in Java.

VAN DILLIEN, L. R., *Uitkomsten van de enquête over sheetbereiding. Archief voor de Rubbercultuur in Nederlandsch Indië*, Year VII, No. 2, pp. 47-59, tables 2. Buitenzorg, 1923.

In the spring of 1922, the Rubber Experiment Station at Besoeki (Java), instituted an enquiry into the method of working, the cultivation and the yield per hectare of the different rubber plantations. Questionnaires were sent to the owners of fifty plantations accompanied by the request that a sample of the product of May 1, 1922 should be forwarded to the Station. These samples were to be forwarded for examination to the Central Rubber Station at Buitenzorg after having been previously examined by a Commission of brokers for valuation from the commercial standpoint. The Station received a total of 51 samples accompanied by answers to the questionnaire. Results of the enquiry:

Treatment and coagulation of latex.

1) The latex concentration in the district of Besoeki is somewhat low. The enquiry has proved that in 22 plantations, the trees are tapped every day; in another 22 plantations, they are only tapped every other day; and in the rest of the plantations a mixed system is adopted. The average percentage of latex when the trees were tapped daily was 27 and when the tapping was effected every other day it was 28 (although 30 and 35 % might well have been expected).

2) The figures for the latex percentage in lump rubber are often too high; 2 % may be regarded as normal, but in some samples the percentage rose to 6 or 7.

3) As a rule, the latex is diluted to 15 %. It is very necessary to weigh the sheets from time to time and to compare the actual weight with the theoretical weight, viz., the weight calculated from the number of litres of dilute latex introduced into the vessels.

4) Sufficient care is often not taken to see that the right amount of dilution is effected.

5) The managers usually avoid as far as possible the use of chemical substances such as anti-coagulants and anti-oxydants.

6) The amount of acetic acid used for coagulation per litre of latex varies. The figures obtained are not comparable, because anti-coagulants are employed in some plantations; further in some cases, the rubber is coagulated the day the tree is tapped, whereas in others it is left till the following day. The average in the case of 8 plantations where no anti-coagulants were used and the treatment was carried out on the day of tapping, was 128 c.c. of 1 % acetic acid per litre of dilute latex, but only 120 cc. in 10 plantations where the operation was deferred until the following day.

7) There are many variations in the methods of making the sheet rubber. The mass is gradually rolled and pressed to the fullest extent on the same day. The sheets are washed during the night, and on the following day they are suspended for some hours in a current of air and subsequently smoked.

The avoidance of air-bubbles and oxidation patches are some of the chief advantages of this system.

8) Driers with different compartments are generally used. The average length of the drying operation on 46 plantations is 14 days. The colour of the sheets varies according to the smoking method adopted.

The rollers also vary greatly in the different plantations. The largest rollers seem to be the most effective as they can turn out heavier sheets which increases the capacity of the machine (number of kg. of rubber per hour). The capacity is much influenced by the number of sheets passing through the machine. Further, the sheets can be made of a given width which is very important for packing. Spirally engraved rollers give the best design for square blocks.

The susceptibility to mould is determined by cutting off a small piece of the sheet, which is then infected with mould and placed in a desiccator with a 7 % solution of sea-salt. The growth of mould at the end of 6 days is regarded as showing average susceptibility. Most of the samples were only slightly susceptible.

Estimation from the external characters as compared with estimation from the internal properties.

10) The thickness and the print were generally good. The prescribed thickness is 3-4 mm. which was attained by 37 samples. Thinner sheets are soft, while very thick sheets dry too slowly and always retain a certain amount of moisture. Too flat a sheet also dries with difficulty.

11) The brokers' Commission passed 34 samples, 7 of which were judged as "very good" and 27 as "good"; 10 were pronounced "in-

ferior", or objected to by one of the members; 7 samples were rejected by the Commission, which exceeded the number expected.

12) The elasticity was quite satisfactory on the whole. A margin of 10 % can be allowed for the time required for vulcanisation. The average for all the samples was 98.7, or in round numbers, 100 minutes, but one sample took 125 minutes.

At the Central Station, 36 samples were pronounced good, and uniform as regard their internal characters. Of these 36 the Commission rejected 5 and classified 8 as doubtful.

One of the samples accepted by the Commission was rejected by the Station. Five samples were regarded as doubtful by the Station; of these 4 had been cured too quickly and 1 too slowly. The Commission accepted 3 of these 5 samples and rejected the other two.

Thus, the verdicts of the Station and Commission did not always coincide, but they invariably agreed when the samples were rejected on the score of impurity.

D. v. S.

625. The Smoking of Rubber.

ULTEE, J. A., Het rooken van rubber. *Archief voor de rubbercultuur in Nederlandsch-Indië*, Year VII, No. 2, pp. 60-74. Buitenzorg, 1923.

I. Historical Review.

The author has made a series of experiments on smoking rubber at Djember (Java) and in the present paper, he gives the results of those investigations that it is useless to continue. The first part of his article contains a historical review of the question of smoking rubber, the following authorities being quoted.

PIT and JONG. *Compte rendu de l'exposition de caoutchouc à Singapoore en Août 1906 (Teysmannia)* p. 641, 1906.

N. N. *Compte rendu de l'exposition de caoutchouc à Ceylan en Septembre 1906 (Rubber in the East etc. 1906)*.

HERBERT WRIGHT, *Hevea brasiliensis*, 1908.

SCHIDROWITZ. Rubber, 1911.

SIDNEY MORGAN The Preparation of Plantation Rubber, 1913.

EATON, *The Agricultural Bulletin of the F. M. S.*, Vol. III, 188, 1915

CAMPBELL, *Bulletin* 27, 1916, *Department of Agriculture*, Ceylon.

WHITBY, *Indian Rubber Journal*, 51, 829 (1916).

DE VRIES Bereiding en Eigenschappen van Plantagerubber 102 p., Estate Rubber pp. 316.

The author agrees with EATON, who says that smoking has no deleterious effect upon rubber; at most, it may slightly increase the length of the vulcanisation process, but for practical purposes, there is no object in continuing research on the effect of the smoke treatment upon the internal properties of rubber.

No way of preventing mould by smoking has yet been discovered. It is generally admitted that the tendency to mould formation is decreased by immersing the sheets of rubber for some hours in running water, but this treatment has many disadvantages, therefore an attempt is now being

made to regulate the smoking process in such a manner that the disinfecting action of the smoke may act long enough to make washing unnecessary.

II. *Increase of weight by smoking.* — The author has estimated this increase by comparing two sheets made from the same latex, one dried by smoking, and the other dried at the same temperature without smoking. He applies the term "smoking coefficient" to the weight of a sheet expressed in percentages. The author is of opinion that this coefficient should vary between 0.50 and 0.75 %. If bisulphide is used as an anti-oxidant, as much as 1 % may be employed without the sheet appearing over-smoked. As it is almost impossible to conduct the experiments under absolutely comparable conditions, all that can be done is to reduce the errors by making a large number of experiments.

The author analysed 9 different sheets before and after smoking. He estimated the ketone-soluble substances and the loss in weight at 100° C. The sum of these two values in the case of smoked sheets, less the sum of the same values in that of the unsmoked sheets, is generally equal to the smoking coefficient; in some cases, the coefficient is lower, which means that the rubber absorbs during the smoking process, substances that are not soluble in ketone. This is especially noticeable in the smoking of crêpe.

III. *Effect of smoking on the viscosity.* — With the object of ascertaining the effect on viscosity of the smoking treatment as practised on the different estates, certain sheets of damp rubber were divided into several parts that were sent to be smoked; lot *a*: all the pieces were smoked for the same number of hours; lot *b*: all the pieces were smoked till they assumed the same colour as the product of the plantation in question. The differences in viscosity were not great. This property was found to be sometimes decreased and at others increased by smoking, which has a very irregular effect upon the rate of vulcanisation, but the author does not assert that any correlation exists between rate of vulcanisation and viscosity, for before this could be proved it would be necessary to conduct special investigations.

D. v. S.

626. The Cultivation and Industrial Value of Lac in the Plains of India.

MISRA, C. S. (First Assistant of the Imperial Entomologist). *Agricultural Research Institute, Pusa, Bulletin* 142, pp. 1-82, plates XXIII, figs. 14. Calcutta, 1923.

The lac industry is very widespread in the Plains of India and helps the cultivators to tide over financial stress at a time when rates are low and climatic conditions are against them in disposing of their produce on the market. On an average over 450 000 maunds (1 maund = 80 lb.) of shellac is exported yearly from Calcutta. The methods of refinement are similar to those adopted in Indo-China (1).

The author describes the distribution areas in the Plains and the

(1) See R. 1916, No. 895, R. 1919, No. 207 and R. 1921 No. 950. {Ed.}

trees on which *Tachardia lacca* is found growing spontaneously, the chief being "ber" (*Zizyphus Jujuba*), "palas" (*Butea frondosa*), "Kusumb" (*Schleichera trijuga*), "pipal" (*Ficus religiosa*), "bubul" (*Acacia arabica*), "arhar" or "tur" (*Cajanus indicus*). Full details and illustrations are given of the brood-lac and inoculation process, localities suitable for lac, instruments, time and labour required for the work, pruning methods, life history of *Tachardia lacca* (1) determination of the emergence of larvae, natural enemies, yield and scraping, storage and washing processes. The importance of fumigation with carbon bisulphide is emphasised, owing to the harmful effect of insects (details of fumigation box are described). Observations on the value of washing, show that 80 lb. of "ber" stick lac ground and washed with water will yield 37 lb. of clean seedlac with 30-32 gallons of workable lac-dye.

The various uses of the pure resin known commercially as seed-lac (for shellac) and of lac-dye are given and the manufacturing process adopted in India. Warnings are given as regards adulteration of shellac, and the advisability of having direct specifications from the manufacturers.

Recommendations for the extension of lac cultivation: — 1) The issue of reliable forecasts. The sudden market fluctuations have hitherto led to slackness on the part of cultivators and subsequent decrease in yield; 2) Manufacture of unadulterated shellac; discarding of adulterated material; 3) Establishment of nurseries; 4) use only of "phunii lac" i. e. stick lac collected after the emergence of young insects, and never of material collected before swarming; 5) utilisation of neglected areas or poor soil for *Zizyphus Jujuba*, and *Butea frondosa*, which require little care when once established. Cultivation on the block system is advised with shade plants such as *Bassia latifolia*, *Pongamia glabra* and *Acacia arabica* between the rows. These trees have an industrial value for motor fuel; *Schleichera trijuga* is advised for clay soils, preferably near water; this tree becomes fit for inoculation 15-20 years after planting and serves also a useful purpose as timber and for oil supplies; 6) exchange of brood lac: — broods from *Zizyphus Jujuba*, should be put on other trees of the same species. This holds good also for *Butea frondosa* and *Schleichera trijuga* although in the last case in the Central Provinces an exchange from *S. trijuga* to *B. frondosa* has proved successful. In West Bengal good results have been obtained by putting *B. frondosa* brood lac on *Z. Jujuba* but not vice-versa.

The appendix includes data relative to all trees on which lac can be grown with their botanical and provincial equivalents. Apart from those already mentioned, these include: *Ficus benghalensis*, *F. infectoria*, *F. glomerata*, *Albizia Lebbeck*, *Shorea Talura* and *Zizyphus Xylopyrus*. Some useful formulae for use of small quantities of lac produced locally and which have no marketable value are given: 1) for making spirit varnish (methylated spirit 10 oz. + white resin 1 oz. + seed lac 1 oz. + Dragon's blood 1 oz.; 2) for making French polish (methylated spirit 20 oz. + seed lac (ground fine) 2 oz. + boiled linseed oil (small quantity).

With reference to cost of production, the author states that no ac-

curate figures can be given owing to the recent rise in wages and prices of brood-lac. Special reference is made to the economic system adopted in Bengal and Bihar and Orissa: the "ber" trees are grown on the field embankments, out back very year carefully and inoculated with brood-lac. A good-sized "ber" will yield about 40 lb. M. L. Y.

627. **Tapping of Karai Gum (*Sterculia urens*), in India.**

ABDUS SALAM, M. *The Indian Forester*, Vol. XLIX, No. 6, pp. 303-306. Dehra Dun (United Provinces), 1923.

Different methods of tapping *Sterculia urens* for the "Karai" gum have been tested in the Central Provinces, India (Melghat Division), and from the available data it appears that the highest percentage of gum is obtained from the "4-oblong notch system" (one on each side of the tree and extending about $\frac{1}{4}$ of its girth; lowest notch 2 ft. above ground), giving an average per tree of 59 lb. The removal of the 6 ft. wide band from all sides, *i. e.* light girdling, has also been found successful; average yield per tree of 57.5 lb. The importance of a straight clean cut and removal of the gum after it is fully dry is noted. The quality of the gum is superior and the method of collection is easy and under normal conditions and provided that the trees do not lose their vitality after the rains are over, these methods can be highly recommended.

The following observations were made during the course of this experiment:

- 1) Trees situated on northern or eastern slopes give more gum than those situated on southern or western slopes.
- 2) Notches cut on the northern or eastern sides of the tree are the most effective.
- 3) Loam or alluvial soils are preferable to rocky or precipitous slopes.
- 4) Trees in shade give more gum than those standing in the open.
- 5) Wet or fresh gum loses about 15 % weight in drying.
- 6) At least one month should be allowed before the first collection of gum is made, to allow the gum to exude and dry properly. Subsequent collection may be made once a month. M. L. Y.

628. **Camphor Cultivation from *Cinnamomum Camphora* in Northern India.**

HOWARD, H. S., ROBERTSON, A. H., and SIMONSEN, J. L. *Indian Forecast Records*, Vol. IX, Part VII, pp. 1-34 Plates 5, tables 6. Dehra Dun, 1923 (1).

Camphor is principally grown in Formosa and the world's supply is largely controlled by Japan. The Japanese and Chinese distil camphor from the wood of mature trees, a destructive method. The author's experiments have been carried out on a small plantation established at Dehra Dun in 1898, with a view to ascertaining the yield per acre, using

(1) See R. 1920, No. 528; R. 1920, No. 646; R. 1921, No. 294; R. 1921, No. 1006. (Ed.)

		Yield calculated on weight of material in column 4													
		Weight (Leaves)			Crude Camphor		Camphor oil		Camphor and oil		Camphor redistilled from oil (sol. 7)		Total Camphor col 5 and col. 7		
		Green	Air dried	Dried at 100° C.	Total	Per cent.	Total	Per cent.	Total	Per cent.	Total	Per cent.	Total	Per cent.	
I	2	3	4	5	6	7	8	9	10	11	12	13	14		
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
Per acre per annum	83.70	40.50	31.50	13.86	0.44	100.17	3.18	114.03	3.62	30.05	30.00	43.91	1.39		

the leaves as the source of camphor in place of the tree itself, also to find the number of flushes of leaves which might be taken per annum.

It was found that a new leaf takes about two months to grow to full size after a flush had been cut, and four flushes were taken from May to November, but little difference was found in the yield of camphor whether two or four flushes were taken, due probably to the higher camphor content of more mature leaves.

A forecast of yield is given by the authors, based on data obtained during three years' investigations, full details of which are given in the article.

When forming a plantation it is recommended that seed be germinated in a nursery and the seedlings transplanted rather than that the sowing be made in the field. At 5 years the plants will be large enough for cutting back, although full yields may not be obtained until a little later. Details are given respecting transplanting and cultivation.

The distillation of the camphor is fully described, and the financial prospects of the industry discussed.

As a result of their investigations the authors conclude that camphor may be easily cultivated in all parts of India with a rainfall of 40 inches and over, but that as a commercial enterprise it should not be grown outside the tropical areas.

W. S. G

629. *Copaifera* spp. and Production of Copal Oil in Brazil.

TRIXEIRA, E. Huile ou baume de Copahu. *Ministère de l'Agriculture, de l'Industrie et Commerce, Service des Renseignements*, pp. 1-3. Rio de Janeiro, 1923.

Species of *Copaifera* are found growing abundantly in Brazil, especially in the State of Rio de Janeiro. The author gives a brief review of the oil value and the synonyms employed relative to the different types. Special attention is drawn to the observations made by M. LE COINTE in the Amazon district.

In the north, *Copaifera reticulata* has the highest oil value, followed by *C. Martii*, noted also for the superior quality wood. Further south, the species *C. officinalis* and *C. Langsdorfi* are the most common.

The yield of oil per tree is estimated at 4.5 litres, and at times as much as 15-18 litres (80 %). The author gives a description of the chemical composition and general characteristics of the oil. Distinctions are also made between the appearance of the trees. The method of extraction recommended by LE COINTE is given namely the insertion of a bamboo in the trunk having first made a hole in the upper and lower portions of the bark. The oil passed through the bamboo tubing is easily collected.

Data relative to the exportation of copal oil from Brazil since 1863 are given. In 1921 the exports amounted to 135 518 tons (valued at 250 contos, 434 milreis). A table shows the exportations into Argentina, England, France, Germany, Italy and the United States, years 1910-1918.

M. L. Y.

630. " Resine de Canarium " of Tonkin.

Bulletin Economique de l'Indochine, Résine de Canarium du Tonkin, Year 25, No 154, pp. 359-360. Hanoi, 1922.

This oleoresin derived from a species of the Fam. *Burseraceae* growing in Tonkin is a black, fairly plastic and tough material, slightly sticky and with a lemon coloured and glutinous interior, and with a pleasant odour. The composition is similar to other resins, but in this respect, the lack of saponifiable resins, capable of giving acid resins should be noted.

The sample examined, however, contained 28.8 % by weight of resinous substances, but quite apart from the question of reaction and classification.

The proportion of volatile oil is 12.3 % and after distillation is considered of commercial value as a fairly cheap perfume. If distillation is carried out at a comparatively low cost and regularly, it should be possible to produce sufficient quantity to act as a substitute for the increasingly scarce and costly terebenthine, to supply local and export needs.

R. D.

631. The Time of Harvest in the different Sugar-Producing Countries.

V. HARREVELD, J., De ovg tyd in verschillende suikerlanden. *Archief voor de Suikerindustrie in Nederlandsch-Indië*, Year 31, No. 36, pp. 43-946, figs. 2. Soerabaja (Java), 1923.

The American Sugar Refining Company prints in its annual report for 1922 of the world's sugar production in relation to time of harvest, a graphic chart which we here reproduce:

The outer circle is divided into 12 equal segments representing the months of the year. The sugar production in the different countries is shown by dark lines. The size of the harvest is given by the distance between these lines and the central point of the circle. In order to facilitate comparison, amounts up to 1, 2, 3 and 4 million tons are shown by the radii of concentric circles. Europe, considered as a unit, is the only producer with an output exceeding 4 million tons. In this chart, Australia with a production of 250 000 tons, and Africa with a output of 550 000 tons, do not appear, probably because these figures are the returns from many small crops that are not large enough to be introduced into the diagram.

Let us study the chart beginning with *December*, when the season of two of the largest producers begins. At this time the sugar-beet harvest is at its height in Europe; the sugar-cane harvest is beginning in Cuba and British India, while it is in progress in many parts of South America (Brazil, Peru, Demerara); in the United States, the sugar harvest is drawing to a close, it is beginning in Hawaii, and in progress in Formosa and the Philippines, while it is at its height in Louisiana.

In *January*, the sugar-beet harvest is at an end in Europe; the sugar season is gradually reaching its maximum in Cuba, is in progress in British India and some of the countries of Central and South America (West Indies, San Domingo, Peru, Brazil), as well as in Hawaii and Formosa and

the Philippines, though it is only just beginning in Porto Rico and is finished in Louisiana

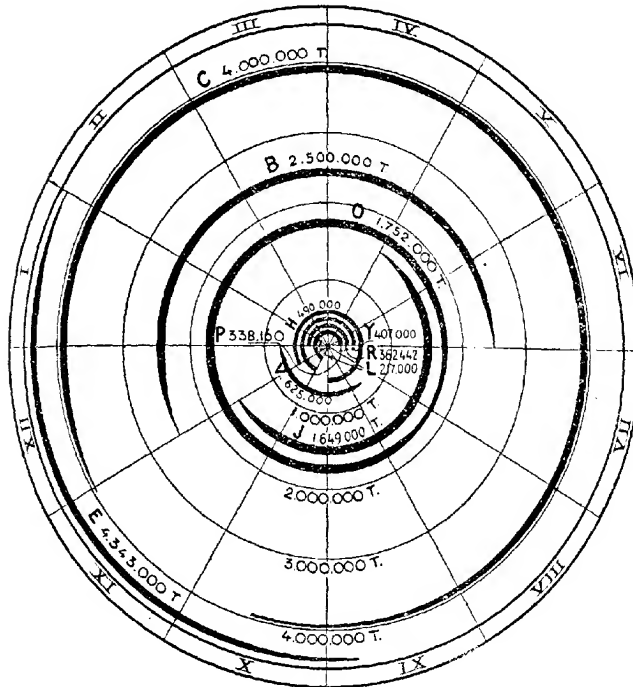


FIG. 106. — Sugar Production in different Countries (in Tons).

- | | |
|-------------------------|---------------------|
| I-XII = Months of year. | L = Louisiana |
| B = British India | P = Philippines |
| C = Cuba | R = Porto Rico. |
| E = Europe | V = Various |
| H = Hawaii | Y = Japan, Formosa. |
| J = Java | |

In *February*, the sugar season is in progress in Cuba, British India, several parts of Central and South America (West Indies, San Domingo, Peru, Brazil) and in Hawaii, Formosa, Porto Rico and the Philippines. Except in the case of Brazil, where it finishes in February, the sugar harvest continues through March, April and May, while it begins in the latter month in Demerara, Argentina and Java.

In *June*, Cuba is still occupied with the sugar harvest but it is finished in British India. As regards Central and South America the season is finished, whereas it is still in progress in the West Indies, San Domingo, Peru and Argentina; it attains its maximum in Java and Hawaii and ends in Formosa, Porto Rico and the Philippines.

In *July*, the sugar production of Cuba begins to fall off greatly; of the States of Central and South America, Argentina and Peru alone have a large output, the harvest is in progress in Java and Hawaii.

In *August*, only a few sugar-factories are working in Cuba; the figures for Central and South America, as well as for Java and Hawaii, are the same as in the preceding month. The sugar-beet harvest begins in the United States.

In *September*, the last factories in Cuba are shut down; it is quite exceptional for any to continue working up to October. No change in Central and South America. — Java and the United States are beginning and Hawaii is finishing the season.

In *October*, the beetroot sugar season begins in Europe. In Cuba the sugar season is ended; in south America, Demerara and Brazil it is beginning; in Peru and Argentina it continues, as it does also in Java and the United States.

In *November*, the sugar season reaches its height in Europe; in South America, Demerara, Brazil, and Peru it is in progress, while in Argentina it is at an end, and also in Java. In the United States, the beet sugar industry is working to the fullest



FIG. 107. — Total sugar production for various months. Letters A-N = months of year.

extent; in Formosa, the Philippines and Louisiana, the sugar season is beginning, in fact, in the latter State, it may be said to have commenced in October.

It would appear that sugar-production never stops, but as always in progress in a certain number of countries with a large output (only countries producing over 100 000 tons of sugar per annum have been taken into account). There are, however, considerable differences in the number of tons produced. Graphic chart No. I registers the production of nearly 17 million tons. The total production each month can also be shown graphically.

Expressed in thousands of tons, it would be as follows :

January	2380	July	875
February	1150	August	875
March	1150	September	586
April	1150	October	1623
May	1385	November	1739
June	1385	December	2404

These figures are represented graphically in fig. 108.

Thus, September marks the lowest level of the world sugar production which later rises rapidly to attain its maximum in December and January, to again decrease regularly with a slight rise in May and June.

D. v. S.

632. Deterioration of Sugar-Cane after Cutting.

LEE, H. A. and CLARA, F. M. *Journal of the Board of Agriculture of British Guiana*, Vol. XVI, No. 2, pp. 99-101. Demerara, 1923.

The work was undertaken to ascertain the loss in sugar between harvesting and milling the cane.

The first experiment was to determine the loss caused by topping cane; that is, cutting off the points for seed, and allowing the cane to stand in this condition. It was shown that cane harvested and milled the same day gave a polarisation of 16.74 % and a purity of 89.1 % whereas when cut and carried four days after topping, these figures had fallen respectively to 13.91 and 73.2.

The second experiment ascertained the loss caused by cutting cane and allowing it to lie in the field before loading and milling. The results are shown in the following table :

Day	Polarization %	Purity %
1	16.56	89.0
2	15.20	81.0
3	14.78	77.0
4	13.80	71.1
7	13.68	68.7

These data show the necessity for rapid handling of cane when harvesting, so as to avoid the loss which occurs when cane is allowed to lie in the field after cutting and before it is milled.

W. S. G.

633. Tea Selection in Java from 1915 to 1920.

COHEN STUART, Dr. C. P. *Verslag over de selectie-werk Laamheden 1915-1920. Mededeelingen van het Proefstation voor thee*, No. LXXXII, pp. 1-60, figs. 7. Batavia, 1923.

This report is a continuation of Mededeeling XL (1916) where a detailed account of the various problems involved in tea breeding is to

be found. This paper deals with four sorts of selection work: 1) work done in the seed garden at Tjinjiruan (Bandoeng); 2) accurate description of the characteristics of commercial seed types; 3) the creation of special seed gardens (immunity, quantity, quality); 4) study of the literature on foreign tea districts and the import of new types.

1) As the nurseries have been used up entirely, the selection gardens at present chiefly consist of seed gardens. Besides some plants and seeds received from Cochinchina in 1916 and plants obtained from Tonkin were planted in the type collection. Seeds and plants from Siam received in 1918 did not turn out well.

The author explains why the seed gardens at Tjinjiruan are designated by population numbers instead of the current commercial names, which would be misleading to the real nature of the selected seed types, and would divert the attention of purchasers from the object, to obtain seed types excelling in essential properties (viz — large production, immunity against *Helopeltis* etc.), not in names or in outward appearance. Besides the original populations have been selected and thinned out until only about 0.1-0.2 % are left as mother trees.

The author includes figures showing a good mother tree, views of the populations after thinning out, and a simple device for counting large numbers of tea seeds.

2) Repeatedly the author was requested to formulate the botanical characteristics distinguishing the commercial types. Such "ready eye-marks" as Sir G. WATT (1) published are, however, not reliable. To the author it seems impossible to formulate, as all commercial types are populations in the genetic sense, i. e., mixtures, both outwardly and constitutionally widely heterogeneous.

It is, notwithstanding possible to determine the *fitness* of a given population, by making a "population analysis", i. e., by counting in a certain nursery the hybrid plants, such with good branching the ill and badly developed plants. These characteristics at least can be expressed in numbers. Example, 50 plants taken as a sample: Flowering 10 %, diseased 4 %, badly diseased 0. Badly branched 44 %. Bad type 38 %. Badly developed 42 %. Average height 257 cm. (highest 370). Kept for seed garden 18 %.

The author gives in an appendix some results of this method of analysis

3) The author doubts if the choosing of plants with large, soft, light-green leaves can be the right way of selecting. For the next generation more stress should be laid on quantity and quality and resistance against disease. By means of an inquiry among the tea planters it was ascertained that many planters were acquainted with individual tea plants apparently free from *Helopeltis*, or with an extraordinary leaf producing capacity, and some planters had seen bushes resistant against root fungi or scarlet mite (*Brevipalpus*), but only in a few cases these bushes had been marked.

(1) G. WATT, Commercial product of India, 1908, p. 209. Tea and the Tea plant
Journ. Roy Hort. Soc., XXXII, 1907, pag. 64.

The first stage of the investigation on immunity for *Helopeltis* should be to discover and to observe resistant plants; this is most reliable in searching only badly infected gardens, without, however, expecting to find plants absolutely free from disease. External factors producing immunity should be looked for, especially when the "immune" plants are found in little groups. The immune and very badly attacked plants should be marked and later on, grafts of resistant and non-resistant bushes should be carried to another locality, so as to make sure of the inherent factors, and breeding of immune types can be aimed at.

The leaf producing capacity was the object of an extensive series of observations carried out in 1920. It cannot be recognised by mere inspection, as the size of the plant frame is misleading. It has to be determined by a series of pluckings and to be expressed in amount of leaf produced per m² of plucking surface in each separate plant per annum. The best producers are to yield grafting material for a special seed garden which is to be compared with a "contra selection" of medium producers.

The selection of high quality tea does not seem to be worth while as the tea market is very conservative and big tea brokers do not like novelties.

The author describes however some selection work done in this direction (selection of dark and light-green plants).

Import and investigation of new types is of small interest in tea selection. In Java, after the first importation of China seed about 1830 and Assam type about 1880, there has not been introduced any essential new type, with the exception perhaps of Manipur and Burma seed. The question is whether, in the case of tea, original planting material should be introduced or not. The possibilities in the way of selection are not exhausted, as far as concerns the tea stock present in Java, since selection has only recently been adopted. The author then reviews his studies of foreign literature and information received from Indo-China, Tonkin, Assam, Cochinchina, Burma, Siam, Calcutta, Singapore, Japan and China.

The last chapter of the report contains a programme for the Tjinjiruan gardens. When all the grafting work has been carried through, seed production is expected to begin (for 9 gardens) about 1928, and for 8 gardens about 1930. The plants selected on account of their leaf production capacity may yield seed between 1928 and 1933. Of course, in any case, the offspring must be carefully tested before any guarantee about the seed quality can be given, so that the terms mentioned above should be extended by about 5 years.

The volume contains two tables: a plate of the selection gardens, and a specification of the nurseries. Also 3 short appendices on the same questions, which had been published in other reviews; 7 photographs and a map of the seed-gardens of Tjinjiruan.

D. v. S.

634. Care of Tea-Seed Bearers.

AUCHINCLOSS, G. C. *The Tropical Agriculturist*, Vol. LX, No. 2, pp. 69-72, plates 2. Peradeniya, Ceylon, 1923.

The diminution of seed from tea-seed bearers, has recently been under investigation. From data obtained by the Department of Agri-

culture it is shown that in some cases the yield from trees 25-35 years old has been reduced by 50 % during the past ten years. As the plant lives for 75 years at least, this cannot be due to old-age.

Examination of seed-bearers shows that these are often over-crowded. Tea-plants are normally spaced $3\frac{1}{2}$ to $4\frac{1}{2}$ feet apart, which is sufficient when the plants are pruned to a height of two or three feet, but when allowed to grow for seed they reach a height of 15-20 feet, and need a space of not less than 12-15 feet square. In consequence, lateral growth is decreased and vertical growth increased, which causes the production of wood and also a diminished leaf-surface, on which the seed depends. Improvement may be effected by the removal of some of the weaker trees and by the pruning of non-productive wood, but it is doubtful whether abnormally tall trees would be able to spread laterally and so increase their leaf surface sufficiently.

When planting new areas it would be better to set the bearers at intervals of 12 feet, or 300 plants per acre. Attention should be paid to pruning, so as to produce a wide-spread head, as seed is borne chiefly on the periphery of the head. New and productive branches must be forced annually by cutting back the older laterals, and light and air must be admitted.

W. S. G.

635. Hop Investigations, Wye College, England.

SALMON, E. S., and BURGESS, A. H., *Journal of the Institute of Brewing*, Vol. XXIX, No. 6, pp. 400-410. London, 1923.

The Institute of Brewing Research Scheme includes The Hop Nursery and its extension, under the charge of Prof. SALMON, allows for growing about 5000 varieties of hops. Many of these are worthless as commercial varieties, but are valuable for use as parents in cross-breeding. A record is kept of the seedlings as regards yield, brewing qualities, and resistance to disease; cuttings are taken from promising seedlings and tested on commercial lines, worthless plants being removed and their places taken by fresh seedlings.

From tests made in the greenhouse during 1922 no less than 348 new seedlings were found to be resistant to "mould", in most cases the resistance was complete. These seedlings were the result of crosses between the Golden Hop and certain of its seedlings, Bates Brewer, and a male hop from America, immune to "mould". Crosses were made between hybrid seedlings of American origin with the highest resin-content and selected male hops, some of which are immune to "mould".

At the Institute's Experimental Oast, Paddock Wood, thirteen series of experiments were carried out by A. H. BURGESS, with respect to the drying and sulphuring of hops, the following conditions being studied:—

- 1) Variation of amount and time of application of sulphur.
- 2) Variation of temperature.
- 3) Variation of air-speed.

1) *Variation of amount and time of application of sulphur.* — The amount and proportion of the resins, and the rate of drying was found to

be unaltered by the use of sulphur; hygroscopicity after drying was unaffected. The sulphured hops had a better colour than those unsulphured, and the best colour was obtained by burning the sulphur one hour after loading. A bad colour was caused by sulphuring just before the hops were finished.

2) *Variation of temperature.* — The ratio of hard to soft resins was unaltered by temperature in drying. Temperatures employed ranged from 122° F. to 212° F. Laboratory experiments show, however, that the soft resins are changed to hard by continued heating at 212° F.

It was found that hops are liable to become "reeked" if the initial temperature rises above 140° F. with an air current of 23 feet per minute.

3) *Variation of air speed.* — Air speeds varied between 13 and 64 feet per minute. No alteration was found in the amount or ratio of resins. With high speed air currents "reek" was caused, which was not the case when a lower speed was employed, the temperature being the same. The rate of drying appears to vary in proportion to the square roots of the air speeds employed. The residual drying power of the air was tested in all the experiments.

W. S. G.

636. Variations in the Scent of *Artemisia* as a Result of Grafting.

DANIEL. La variations des parfums sous l'influence du greffage. *Comptes Rendus des séances de l'Académie des Sciences*, Vol. 176, No. 15, pp. 999-1001. Paris, 1923.

In the course of a series of grafting experiments on aromatic plants, the author has noticed an interesting effect produced by the stock on the scion and *vice-versa*.

Thus, *Tenacetum* and *Artemisia*, when grafted on *Chrysanthemum frutescens*, become perennial, while their leaves decrease in size, and change more or less in shape and colour; on the other hand, the hardness of the *Chrysanthemum* is increased.

With these morphological modifications, which are noticeable the first year, but become accentuated as the plant grows older, are associated alterations of scent and flavour that also increase with the age of the plant. A scion of *Artemisia absinthium* with very delicate, finely-divided leaves produced after three years, normally developed seeds capable of germination. In one of the seedlings raised from this seed the type characters had been distinctly modified by the effect of the grafting. The progeny of this plant was composed of individuals of very varied appearance, some much resembling the normal form, while others had finely divided leaves; the two extremes were connected by all the intermediate grades.

These phenomena prove that in *Artemisia*, as in many other species, symbiosis not only affects the grafted plant, but also its progeny both in a negative and positive manner.

The author is of opinion that research in this direction might afford results of great importance to the perfume industry.

G. A.

[636]

637. History and Status of Tobacco Culture in the United States.

GARNER, W. W. and MOSS, E. G. (Bureau of Plant Industry), and YOHE, H. S., WILKINSON, F. B., and STINE, O. C. (Bureau of Agricultural Economics). *United States Department of Agriculture, Year Book 1922*, pp. 395-468, figs. 28. Washington, 1923.

During the five-year period 1917-1921, the average area reserved for tobacco in the United States was 1 702 000 acres, the production 1 362 000 000 lb. and the average crop values was \$364 620 000. This output, which leads the world, includes a great diversity of types of tobacco. Kentucky, North Carolina and Virginia produce two-thirds of the total yield. The magnitude of manufacturing operations is indicated by the census returns. For comparative purposes a survey is made of the world production of tobacco followed by a review of the acreage, yield and production in the States. The marked increase in average production since 1879 is very striking viz. 350 000 000 lb. risen to 1 075 418 000 lb. in 1921.

Historical development. — A report of the origin and gradual development of production and the changes occurring in various States. There has been a tendency throughout towards increased specialisation, and it has been gradually evolved that each set of types of tobacco can be produced only under certain special conditions of soil and climate and by adopting certain methods of growing and handling the crop. Each producing section supplies a definite type peculiarly suited for specific trade purposes.

CLASSIFICATION OF TYPES: a) Dark fire-cured and air-cured; b) bright flue-cured; c) cigar leaf; d) white Burley. The present geographical distribution of these types is given, the development traced and the respective values are cited. Types b) c) and d) show a marked increase in production in recent years.

Factors influencing production.

1) *Systems of cropping*: A comparison is made between the systems adopted in different States and it is of interest to note that a well-balanced rotation — wheat, grass, clover, maize, tobacco, on heavy soils in Lancaster Pa. has given more regular and satisfactory results, including the evident value of winter feed for stock, than the highly intensive one-crop system on the lighter loams in Connecticut. The large yield in the second case is liable to decline at a certain period.

However, in order to maintain constant quality of tobacco from year to year, the prevailing practice in Maryland has been to grow two or more crops of tobacco on the land, chiefly without manure, and in some cases with a catch crop of wheat; this is followed by maize after which the land remains fallow for some years. Under this system the yield has remained constant at approximately 700 lb. The system of continuous cropping and lying fallow has also been adopted in North Carolina, except that more fertilisers are used.

2) *Influence of soil and climate on quality*: The differences in quality are emphasised — and the deleterious effects of water-logged soils,

drought, frost etc. A report is given of investigations on the correlation of weather and yield in Ohio and Kentucky. The importance of fairly high temperatures and a moderate evenly distributed rainfall is generally recognised. The physical and chemical nature of the soil constitutes an important factor in leaf development: the cigar wrapper and binder types are grown on sandy loams with low water-holding capacity

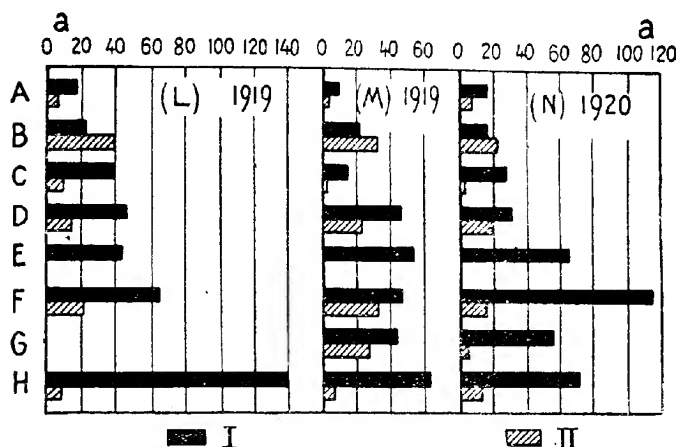


FIG. 108. — Distribution of labour in growing of tobacco three producing districts.

- | | |
|--|--------------------------------------|
| A = Plant bed | F = Harvesting |
| B = Field preparation | G = Curing |
| C = Transplanting. | H = Stripping and marketing |
| D = Cultivating | I = Kentucky Burley 1919. |
| E = Topping, worming, suckering and spraying | M = Kentucky Dark (Fire-cured 1919). |
| | N = Georgia 1920 Bright flue-cured. |

I = Man labour. — II = Horse labour.

(Connecticut, Quincey, Fla. Wisconsin); the cigar filler type on silt and clay loams (Pennsylvania); the Burley on fertile phosphatic limestone (Kentucky and S. Ohio); the dark fire-cured and air-cured on heavy silt and clay loam (Kentucky, Tennessee, Virginia); flue-cured on sandy loam (texture depending largely on subsoil) cigarette and granulated pipe smoking grades on light soils and low proportion of clay subsoil; plugfiller and wrapper grades on heavy soil with more clay in subsoil.

The growing of high grade cigar wrapper leaf from Cuban seed under an artificial shade of cheese cloth or of States is an out-standing development.

Fertilisers. — The respective requirements of the various types is discussed.

Diseases and pests. — The most serious pests are the hornworms (*Pflegeithontius quinquemaculata*) and *P. sexta*. — Others prevalent are *Chloridea virescens*, *Epitrix parvula*, *Lasioderma serricornis*. — Control methods are suggested. The "Wildfire" disease has been the cause of the most damage, although several others are reported. The bluemould has recently been introduced.

Cost of production. — The report includes details with reference to amount and distribution of labour, wages, land rents, costs of upkeep and maintenance of tobacco barns, and the comparative demands for the various types. A grouping of the records for different districts indicates an increase in yield corresponding with an increase in cost per acre and a decrease in cost per pound *e. g.* in Kentucky, farms producing from 600 to 1000 lb. per acre Burley tobacco showed an average cost of \$237 per acre and 30 cents per lb. while those yielding over 1500 lb. per acre showed a cost of \$330 per acre and 24 cents per pound. The fact that rank growth is often associated with poor quality and low returns should be remembered, and risks should consequently not be taken liable to sacrifice quality.

Financial basis. — Tobacco growing has been found particularly suitable for the tenancy system, a method largely adopted in the Southern States; the tenants share of the crop is one-half or two-thirds, depending on the amount of fertiliser furnished by the landlord; the tenant in both cases is responsible for the labour, teams and machinery. — The crop is grown largely on a cash basis. — Under the share-rental system, the tenant usually receives half the value of the crop, and supplies the hand labour, the other items being divided between landlord and tenant. The self-operated method is limited only to certain northern-growing sections.

Marketing. — Three systems are in use: viz. Auction (Maryland, Virginia, Carolina, Georgia, Tennessee, Kentucky, S. Ohio, Indiana and Missouri); farm sales (cigar-leaf sections); co-operative marketing (general). Details are given as to the preparation for auction — and it is noted that the best marketable condition should contain 15 to 30 % moisture; excess of moisture should be avoided. A description is given of the warehouse auction methods: viz. the loose-leaf auction system, selling in packed form at public auction, and the closed-bid method *i. e.* samples displayed by the broker or commission merchant and bids collected for the same.

In farm selling, scarcely any attempt is made to classify tobacco with respect to quality and sales are made for a general average price. The contract method is largely practised.

The co-operative marketing includes three distinct lines:— co-operative packing, co-operative sales agencies and co-operative pooling. Each is described fully in the report. The most common form practised is the pooling or co-operative association system. From 50 to 75 % of the tobacco production in a particular section is determined upon as a goal, and the organisation does not proceed to act until this percentage has been pledged to the pool by individual farmers who sign contracts, agreeing to sell and deliver their entire crops for a certain fixed number of

years to the pool, which undertakes to sell the tobacco and present returns to the farmers after deduction of operating expenses. These associations are organised without capital stock; the tobacco received is sorted and graded and advance payments made accordingly. The subsequent sale to dealers or transmission for shipping purposes is entirely in the hands of the association.

Prices. — The data obtained is based on geographical division of types rather than on actual characteristics, owing to the absence of a uniform system of grading. A graph illustrates the rise and fall from 1865 to 1921. A survey is made of the locations of licensed warehouses and the licensed inspectors, graders and weighers. The average farm price for the 1921 crop was about 89 % above pre-war figures.

Exports and Imports and Home Consumption. — The gradual increase in export trade during this last three centuries is traced — at the close of the war an excess of 750 000 000 lb. is given, the larger proportion being absorbed by Great Britain, the next in order of sequence being France, Italy and Germany (each 10 %), Netherlands (6 %), Spain (5 %), Australia and Canada (each 4 %), Belgium (3 %), China (2.5 %). As regards imports, these are limited to cigar wrapper leaf from Sumatra (average 6 000 000 lb. per annum), cigar filler and wrapper from Cuba (average 22 000 000 lb. per annum) tobaccos from Turkey (26 000 000 lb. approximately).

The per capita consumption of tobacco has steadily been on the increase for many years. This is evident from the figure which shows the home consumption and distribution of leaf in the manufacture of cigars, cigarettes, tobacco and snuff (1897-1921). It is notable that the increase is confined largely to cigarettes. Details are given as to the returns of the Commissioner of Internal Revenue. In 1921 as much as 60 billions of cigarettes were produced of which 8 ½ billions were exported. A comparison is made between the import and export trade of unmanufactured tobacco in the various countries concerned. The United States furnishes 41 % of the total. Full references are given relative to the import duties and internal revenue taxes.

The question has been raised as to the advisability of extending the tobacco crop to new territories. It appears that, taking into consideration the possibilities of production in excess of demand and the marked effects of soil and climate in each region on the type of leaf and the corresponding commercial demands, the exploitation of new territories is not practicable.

M. L. Y.

638. Tobacco Soils and Fertiliser Experiments.

OOSTHUIZEN, J. du P. (Manager, Experiment Station, Rustenburg). *Journal of the Department of Agriculture, Union of South Africa*, Vol. VII, No. 1, pp. 21-35, figs. 5, illustrations 14, Pretoria, 1923.

The results of the author's long series of experiments may be summarised as follows:— Climate and soil influence the character of the tobacco plant and are chiefly responsible for the distribution of the different types

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of tobacco. The grade is more dependent on the cultural methods, the fertilisers, and the curing of the crop. Sandy and sandy loam soils generally produce bright tobacco and heavy clay soils dark coloured tobacco; an exception is the black, clay, norite soil but the high lime content of this soil is probably the cause of the bright leaf.

More attention should be given to the suitability of the soil type in each area; the mechanical composition seems to have greater influence on the type than the chemical composition. Lime is an important factor and was found to increase the yield on the acid soil of the Rustenburg Station, and the same result was obtained with phosphates. Phosphates, and to a lesser extent potash, increased the percentage of cigarette leaf, but nitrogen caused a decrease. Farmyard manure gave the biggest yield and the largest leaves, but lowered the percentage of cigarette leaf. A combination of farmyard manure and phosphates gave a high yield of good quality tobacco; the nitrogen content of a complete fertiliser for bright tobacco must not be high.

W. S. G.

639.⁵ Papaw_x and Papain.

THOMAS ELLIS, and BECKLEY V. A., Grootfontein School of Agriculture, Middleburg. *Journal of the Department of Agriculture*, Vol. IV., No. 4, Pretoria, South Africa, 1923.

The Papaw (*Carica papaya*) is propagated from seed, but good results have been obtained by grafting shoots from selected trees on to saplings. Trees may be planted at distances of 10 × 8 feet. Fruit should be ready for picking in about twelve months after planting the young seedling and the tree continues to be profitable for 4 or 5 years. The yield is about 30 fruits per annum, or a total of 150-200 per tree. The fruit weighs from 2 to 6 lb. The papaw contains papain, an enzyme, used as a drug in place of pepsin. Papain is sold as a soft, creamy powder at a price of about 3s. 2d. per oz.

The latex containing the papain is obtained from the fruits by scratching or cutting the rind with a bone or wooden knife, and collecting the juice in a glass or china vessel. The fruit must not be cut with a steel knife, nor the juice collected in a tin, or the papain will be darkened in colour and of little value. The latex is spread on unbleached linen stretched on frames and dried as rapidly as possible, but the temperature should not exceed 100°F., or the activity of the enzyme is decreased. While still warm the dried material may be ground in a small mill and packed in clean airtight tins, or preferably bottles.

W. S. G.

BIBLIOGRAPHICAL NOTES.

640. GUILLAUMIN A. (Assistant au Museum). Les cultures en Océanie française. *Revue de Botanique appliquée et d'Agriculture coloniale*. Year 3, No. 21. pp. 322-327. Paris, 1932.

A survey of the present position of the following crops in French Oceania: banana, coffee, cotton, vanilla.

R. D.

641. NORTON, L. J. An Economic Study of the Production of Canning Crops in New York. *Cornell University Agricultural Experiment Station, Bulletin* 412, pp. 1-82, tables 82. Ithaca, N. Y., 1922.

Report of investigations made in New York to obtain reliable information concerning the production and cost of the principal crops grown for canning factories, viz. peas, tomatoes, maize, and lima beans and to study some of the factors influencing the economical production of these crops.

M. L. Y.

642. SUTTON, G. L. (Director of Agriculture) and VANZETTI, F. (Wheat Experimentalist). Standard Wheat Varieties for the West Australian Wheat Belt. *Department of Agriculture, Western Australia, Bulletin* No. 111, pp. 4 + map. Perth, 1923.

A summary of the desirable characteristics of wheat varieties and descriptive large scale map showing the distribution in Western Australia of the early, midseason and late zones for planting. The four varieties mentioned are: Yandilla King, Nabawa, Gluyas Early, Florence, all of which are resistant to disease. A short description is given of each, including the two standard oat varieties, Algerian and Burts early.

M. L. Y.

643. SAMPIETRO, G. Ricerche sui rapporti fra la catalasi dei risi e la capacità germinativa (Investigations on Correlation between Catalase content and Germination Capacity of Rice). *Il Giornale di Riscicoltura*. Year XIII, No. 9, pp. 133-141, figs. 1. Vercelli, 1923.

According to the results obtained, the author concludes that rice belongs to a species with a relatively high germination capacity and catalase content. Information at present available does not, however, yet allow of the practical application of this principle for the rapid estimation of the seed value.

F. D.

644. PONSARD J. Une ferme à pommes de terre. *Journal d'Agriculture pratique*, Year 87, No. 21, pp. 417-415. Paris, 1923.

Description of the system adopted on a farm near Paris where the potato is grown in a 2 year rotation with wheat and oats.

R. D.

645. CROUX, P. Les Asclepiades à tubercules à Madagascar. *Revue de Botanique appliquée et d'Agriculture Coloniale*, Year 3, No. 20, pp. 252-257. Paris, 1923.

A description of the 18 *Asclepias* spp. found in Madagascar. Although only a limited number of these tubers are used for food purposes at the present time, a wider knowledge of these plants should result in a more extended use of their nutritive material.

R. D.

[441-445]

646. TRABUT, L. Le Bersim ou Trèfle d'Alexandrie. *Revue de Botanique appliquée et d'Agriculture Coloniale*, Year 3, No. 21, pp. 333-342. Paris, 1923.

The Alexandrian Trefoil (*Trifolium Alexandrinum*) has been successfully used in rotation with cotton in the valley of the Middle-Niger. It is also common in North Africa where it has proved equally satisfactory. The article includes details as to botanical characteristics, varieties, cultivation, composition and utilisation.

R. D.

647. NEIDIG, R. E. and SNYDER, R. S. (Idaho Agricultural Experiment Station, University of Idaho), Sunflower investigations. *Journal of Agricultural Research*, Vol. XXIV, No. 9, pp. 769-780, tables 6. Washington, D. C., 1923 (1).

Discussion on the composition of sunflowers, time for cutting for silage purposes, distance apart for planting, and comparative results obtained in Idaho (U. S.).

M. L. Y.

648. NEIDIG, R. E. and SNYDER, R. S. (Idaho Agricultural Experiment Station). Sweet Clover Investigations. *Journal of Agricultural Research*, Vol. XXIV, No. 9, pp. 795-799. Washington, D. C., 1923.

Report of investigations made in order to test the value of *Melilotus alba* and *M. officinalis* as silage crop substitutes on land not suitable for maize or sunflower in Idaho (U. S.). The report includes detailed analyses of the sweet clover varieties and the silage obtained.

M. L. Y.

649. FERRARA, A. and TITTA, G. A. Composizione chimica dei fieni naturali della Cirenaica (Chemical Composition of Wild Fodder Plants in Cyrenaica). *L'Agricoltura coloniale*, Year XXVII, No. 8, pp. 294-303. Florence, 1923.

Analyses of 26 species of fodder plants, part of a collection sent from Cyrenaica to the "Istituto Agricolo Coloniale Italiano" for botanical and chemical analysis. A detailed table shows the diversity of types found in the different parts of Cyrenaica and a comparison is made with species common to southern Italy and in natural pastures. In general there is a distinct similarity between the three groups.

F. D.

650. DELANOE (Conseiller agricole à la Direction Générale de l'Agriculture). Le Mûrier fourrage d'été (The Mulberry Tree as a Summer Forage Plant). Regence de Tunis. *Bulletin de la Direction Générale de l'Agriculture*, Year 27, No. 112, pp. 103-114. Tunis, 1923.

The author after calling attention to the importance of silk production in Tunisia, notes that the mulberry tree should also serve a useful purpose

(1) See R. 1923, No. 379. (Ed.).

in Northern Africa as a fodder plant. Without irrigation and at a critical period of the year, the summer and autumn, it supplies an abundant green forage which is much appreciated by stock. The article includes details as to methods of cultivation, yield, composition and utilisation in the different countries.

R. D.

651. TISON, L. (Chef du Laboratoire de Chimie de Boma). Le *Dolichos bulbosus*. *Bulletin Agricole du Congo Belge*. Vol. XIV, No. 1, pp. 61-64, 1923.

General review of the forage value of *Dolichos bulbosus* L. (= *Pachyrhizus angulatus*); characteristics and distribution; followed by a detailed analysis of tubers obtained in the Belgian Congo compared in nutritive value with potato, carrot, radish, beet, turnip, Jerusalem artichoke. Reference is made as to the best time for collecting tubers.

M. L. Y.

652. TRABUT L. Le coton à la Ferme expérimentale de "Ferme Blanche", années 1920-21-22 (Cotton at the Experimental Farm "Ferme Blanche". Years 1920-21-22). *Bulletin Agricole de l'Algérie-Tunisie-Maroc*, Yaar, 29, No. 4, p. 61. Algiers, 1923.

Crop yields and economic value of the two cotton varieties "Yuma" and "Pima", selections from the Egyptian "Mitafi".

R. D.

653. Pour l'Olivier. *Compte rendu des Travaux du Vème Congrès International d'Oléiculture*. Marrakech et Rabat, pp. 338 tables and plates. Paris, 1923.

In this work, which is illustrated by numerous photographs, a study is made of 30 reports drawn up by specialists. The following questions are dealt with: the situation of olive-cultivation and of the olive-product industries in Spain, France, Algeria, Morocco, Tunisia and Italy, and the improvements to be introduced; the means of reconstructing old olive-yards and turning to account wild olive-trees; the parasites of the olive and their control; preserved olives; pressing olive pulp; the extraction of olive oil from the skins; the treatment of olive pomace, etc. This book is both scientific and practical and will be very useful to olive-growers, olive-pressers, manufacturers and dealers, for it contains much hitherto unpublished information.

R. D.

654. AUCHINCLOSS, G. G. West African Oil Palm and its Products. *Department of Agriculture, Ceylon*, Bulletin No. 62, pp. 1-18, plates 5. Peradeniya, Colombo, 1923.

A survey of the world's oil palm trade, followed by a description of the oil, fruits and yield in Ceylon compared with the fruits and oil content on the Gold Coast and West Africa. The author discusses also the habit of the palm, the range of climate and soil, methods of cultivation, diseases, extraction of oil, and factory processes.

M. L. Y.

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655. SAMPSON H. C. *The Coconut Palm : the Science and Practice of Coconut Cultivation*, pp. 262. Plates 40, Price 31s. 6d. Published by John Bale Sons and Danielsson Ltd., Great Titchfield St., London, 1923.

The « Coconut Palm », by H. C. SAMPSON, C. I. E. late Director of the Department of Agriculture, Madras, should prove of especial value to all those engaged in the cultivation of the coconut, as the author is both a scientist and an experienced planter.

The book is divided into three sections, the first of which describes the root, stem, crown, leaf, flower and seed of the palm, great attention being paid to the root, which in this plant is of peculiar importance. The second section on management of plantations is thoroughly practical in treatment.

The various stages of the planting and harvesting of the crop, the contingencies and difficulties arising under tropical conditions and the procedure necessary to ensure success are described in detail.

The third part deals with the different coconut products and their preparation for market.

The 40 illustrations are of high value, and the coloured diagrammatic plates showing the composition of the plant and the nut at different stages of growth form a striking and original feature of the work.

W. G. S.

656. CREVOST, C. H. (Inspecteur en Chef des Services Commerciaux) and LEMARIE C. (Directeur adjoint des Services Economiques d'Indochine), *Les matières grasses de l'Indochine. (Oil Plants of Indo-China) Bulletin des Matières Grasses*, No. 3 and 4, pp. 90-151. Marseilles, 1923.

A list of the principal oils produced in Indo-China, giving local and scientific names, botanical and cultural details, and commercial value of those derived from the following plants :— *Amoora* (*Amoora gigantea*), (*Arachis* *Arachis hypogea*), *Brasiletto* (*Caesalpinia bonducella*), *Candlenut* (*Aleurites* sp.), *Camellia* (*Thea Sasanqua*), *Calophyllum* (*Calophyllum Inophyllum*), *Carilla* (*Momordica cochinchinensis*), *Castor oil* (*Ricinus communis*), *Chestnut* (*Aesculus* sp.), *Cotton* (*Gossypium* spp.), *Cynometra* (*Cynometra ramiflora*), *Evodia* (*Evodia fraxinifolia*), *Hemp* (*Cannabis sativa*), *Hickory* (*Carya tonkinensis*), *Hodgsonia* (*Hodgsonia heteroclita*), *Horseradish* (*Moringa pterygosperma*), *Indian almond* (*Terminalia Catappa*), *Kapok* (*Eriodendron anfractuosum*) and *Bombax malabaricum*, *Litsaea* (*Litsaea citrata*), "May chim han" (?) "May hin." (?), *Mangosteen* (*Garcinia tonkinensis*), *Macassa Oil* (*Schleichera trifuga*), *Parinarium* (*Parinarium ananense*), *Perilla* (*Perilla ocymoides*), *Physic nut* (*Jatropha curcas*), *pine* (*Pinus Khasya*), *robinia* (*Pongamia glabra*), *Sesame* (*Sesamum indicum*), *Shaddock* (*Citrus decumana*), *Soya* (*Soya max*).

R. D.

657. PINCHING, H. C. General Principles of Economic Rubber Planting. *The Tropical Agriculturist*, Vol. LX, No. 1, pp. 3-13, Peradinya, Ceylon, 1923.

The author considers the subject under the following headings:—
Selection of land, return on capital, number of trees per acre, square, avenue and quinquex planting, weeding, and thinning out. W. S. G.

658. *The Columbian Review* (Rubber Possibilities in Columbia), Vol. II, No. 3, p. 96. New York, 1923.

The article draws attention to the rise in price of rubber and the threatened scarcity, due largely to the great demand caused by the development of the automobile industry, together with the export duties imposed by Great Britain on East Indian rubber. In consequence, American business men are considering the exploitation of South America, which offers enormous possibilities as regards rubber. Next to Brazil, Columbia is the richest in rubber trees; the principal rubber areas lie near the Amazon River, and in the Choco Mountains, both of which are conveniently situated for transport of the product to the Atlantic or Pacific Coasts.

W. S. G.

659. HEIM F. and CHENEVEAU C. Valeur industrielle de 2 caoutchoucs de plantations d'Annam. *Bulletin de l'Agence Générale des Colonies*, Year 16, No. 181, pp. 8-10. Paris, 1923.

Description of the two varieties of rubber of Cam-Son (Nha-Trang) and Dak-Joppan (qui-Nhon), both derived from *Hevea latex*. R. D.

660. Sugar in Siam. *The Record*, Vol. 1, No. 3, pp. 6-17, Bangkok, 1922.

In this monograph a brief historical sketch is given of the sugar industry in Siam, followed by descriptions of the varieties of cane and palm grown in the country, methods of cultivation and sugar production, and trade statistics. W. S. G.

661. Tea Growing and Manufacture in the Dutch East Indies. *The Spice Mill*, Vol. XLVI. No. 9, pp. 1768-1774, plates 3. New York, N. Y., 1923.

General review of the tea industry and cultivation in the Dutch East Indies, chiefly in Java, including details as to withering, rolling, fermentation, drying, sorting and packing and data concerning area planted and export trade, with descriptive illustrations. M. L. Y.

662. PULLIAM, W. E. Dominican Cacao, *Bulletin of the Pan American Union*, Vol. LVII, No. 3, pp. 245-252, plates 3. Washington, D. C., 1923.

Description of the development of cacao cultivation in the Dominican Republic and statistics concerning export 1920-1921. M. L. Y.

[657-662]

663. STOCKBERGER, W. W. (Bureau of Plant Industry), Growing and Curing Hops in the United States *U. S. Department of Agriculture, Farmer's Bulletin* No. 1304, pp. 1-36, figs. 20. Washington, D. C., 1922.

Although the general methods employed in hop production are well known, the author devotes his attention especially to certain practical principles of great importance to successful hop growing, and gives also a brief general outline of hop culture, including propagation, planting, cultivation, pruning, trellis and other systems of training, packing, curing, baling and marketing.

In the United States, the climatic conditions on the Pacific Coast States appear to be specially favorable to this crop, where abundant early rainfall is followed by warm, dry weather as the plant approaches maturity. The yield varies widely according to locality (in California up to 2 200 lb. per acre; in Washington, 1 200 to 2 000 lb.; in Oregon 1 000 to 1 600 lb. and in New York 800 to 1 500 lb.).

M. L. Y.

664. PORTS, G. (Professor of Botany, Grey University College, Bloemfontein). The Pepper Tree (*Schinus molle* L.) as a Cause of Hay Fever in South Africa. *The South African Journal of Science*, Vol. XIX, pp. 146-195. Tables 21 + charts, bibliography. Johannesburg, Dec. 1922.

Inoculation tests have shown that hay fever patients react to pepper tree pollen and it has been concluded that this tree is responsible for the epidemic in South Africa. The article reviews the climatic conditions in Bloemfontein relative to epidemics in general, and the effect of weather on the drying and dispersal of pollen. The pollen grain is discussed from the standpoint of formation, pollination, distribution of pepper trees and comparative toxicity of the leaves and flowers. Preventive methods are given including the importance of the removal of the male tree. Other possible causes of hay fever are mentioned.

M. L. Y.

665. MASON S. C. (Office of Crop Physiology and Breeding Investigations, Bureau of Plant Industry). The Saidy Date of Egypt and Adaptability to Commercial Culture in the United States. *United States Department of Agriculture, Bulletin* No. 1125, pp. 35, figs. 4, bibliography. Washington, D. C., 1923.

The author reviews the principal commercial varieties of dates, and the character and detailed history of the Libyan Saidy date palm. The facility of propagation, productiveness, packing and keeping qualities and superior quality render this variety of special commercial value. The fact that this date will mature without loss with the relative humidity of the ripening season at from 68 to 75 %, suggests the suitability of the Saidy date for wide areas in California, and Arizona where other imported varieties (e. g. Deglet Noor) will not succeed.

M. L. Y.

666. D'OLIVEIRA XAVIER, J., Notas sobre a cultura do castanheiro no Concelho de Vila de Rei. (The Cultivation of the Chestnut in the Concelho de Vila de Rei). *Broteria, Serie de Vulgarização científica*, XX, Part VI, pp. 251-253. Braga, 1923.

Historical information respecting the cultivation of the chestnut in the Concelho de Vila de Rei (Beira Baixa, Portugal), together with some observations on the advisability of introducing the Japanese chestnut ("Shiga Kouri"), as a means of preventing Ink Disease. This tree has been acclimatised in Portugal and has proved an excellent stock upon which to graft the European variety of chestnut.

F. D.

667. HICKEL R. Le sapin de Douglas. (The Douglas Fir). *Comptes Rendus des sciences de l'Académie d'Agriculture de France*, No. 13. pp. 375-378. Paris, 1923.

The author draws attention to the care required in the introduction of foreign species of forest trees. In one case, however, a certain species, namely the Douglas Fir (*Pseudotsuga Douglasii*) has proved its superiority over similar indigenous species in several parts of France and the article describes in detail the properties of this tree (1).

R. D.

668. WILLIAMS, C. (Chemist, School of Agriculture, Cedara, Natal). The Black Wattle Industry in South Africa. *The Tropical Agriculturist*, Vol. LX, No. 1, pp. 19-35. Peradinya, Ceylon, 1923.

This report gives a botanical description of the black wattle, the early history of the industry, suitable localities for production, area grown and yield, methods of cultivation, cost of production, grading of bark, diseases and pests, and by-products. The article is followed by a short report on the wattle bark industry in East Africa.

W. S. G.

669. SWEET, J. M. *Artocarpus hirsuta* as an Underwood for Teak. *The Indian Forester*, Vol. XLIX, No. 5, pp. 248-251. Allahabad, 1923.

Report of successful attempts made in the teak plantations in Nilambur (Madras) with *Artocarpus hirsuta* as an underwood, following up the satisfactory results obtained in Travancore, which demonstrate the effective prevention of epicormic branches of teak, by adopting this method.

M. L. Y.

670. GREEN, A. W., Shelter Belts and Hedges at Ruakura, New Zealand. *New Zealand Journal of Agriculture*, Vol. XXVI, No. 3, pp. 133-139; pp. 5. Wellington, 1923.

Report of twenty years experience of wind-swept areas in New Zealand and a list of trees and shrubs which have given satisfactory results as ornamental and useful shelter hedges round the farm.

M. L. Y.

(1) See R. 1922, No. 1319. (Ed.).

671. SPILLMAN, W. J. Distribution of Types of Farming in the United States. *United States Department of Agriculture. Farmers' Bulletin No. 1289*, pp. 1-30, figs. 5. Washington, 1923.

The author has studied the factors that control the distribution of types of agriculture, and in this Bulletin gives an analysis of the farming in the United States, and the reasons which are now causing agriculturists to consider the advisability of changing their crops and methods of farming.

W. S. G.

672. ORWIN C. S. (Director of the Institute for Research in Agricultural Economics, Oxford). *Farm Costing and Accounts*. Price 2/- (Successful Farming Series), Benn Brothers, Ltd., London.

This is a practical manual on farm accounting by a high authority on the subject.

W. S. G.

LIVE STOCK AND BREEDING.

SYNTHETIC ARTICLES.

673. Range Plants poisonous to Stock.

I. — FLEMING, C. E., MILLER, M. R., and VAWTER, L. R. The Spring Rabbit Brush (*Tetradymia glabrata*) A Range plant poisonous to Sheep. *University of Nevada Agricultural Experiment Station, Bulletin No. 104*, pp. 29, tables VII, figs. II. Carson City, Nevada, 1922.

II. — IDEM. The Low Larkspur (*Delphinium Andersoni*) Plant of the Spring Range, poisonous to Cattle. *Ibid.*, No. 105, pp. 22, tables, figs. 8. Carson City, 1923.

III. — DWIGHT MARSH, C., CLAWSON, A. B. and COUCH, J. F. (Pathological Division, Bureau of Animal Industry). Greasewood as a Poisonous Plant. *U. S. Department of Agriculture, Circular 279*, pp. 1-4, figs. 2. Washington, W. C., 1923.

IV. — PANISSET, M. L. (Prof. à l'Ecole d'Alfort). Cattle Poisoning by *Sorghum exiguum* (1). Empoisonnement des bovidés par le sorgho à balais. *La Vie agricole et rural*, Year 12, No. 29, p. 46. Paris, 1923.

I. — *Tetradymia glabrata* is a shrub common to the foot-hills in Nevada, U. S., and several other Western States. Observations have led to the conclusion that, although sheep do not appear to like the taste of this plant,

(1) See R. 1919, Nos. 1079, 1104, 1922, Nos. 700, 728. (Ed.)

they will often eat the tender new growth in the spring and early summer if other feed is scarce.

Feeding tests were made at the Nevada Agricultural Experiment Station, and results indicate that sheep can eat nearly 2 lb. without apparent harm; the poison has, however an accumulative, deleterious effect, finally causing severe sickness and death. The active poisonous principle has not yet been discovered; analyses prove that neither the essential oil of the scent, nor the large percentage of potash salts in the buds and shoots are responsible for the poisonous effect. The first symptoms observed are restlessness, refusal of food, twitching of the muscles, and eventual collapse. Attempts to treat this condition have so far proved unsuccessful. Losses have been confined to sheep; there is apparently no danger of poison with cattle or horses.

II. — *Delphinium Andersoni* is common in eastern Oregon, California and Nevada, and is poisonous to cattle but not to sheep. The plant is found usually on sandy loams, and at a time of year when other vegetation is scanty. Experimental feedings have shown that it takes from 20-25 lb. of leaves and flowers to cause any fatal results with a normal animal. The plant appears to be more toxic before flowering than later. The first symptoms of poisoning is the sudden collapse, and little time is left for treatment. Consequently, methods of prevention are advised as regards overstocking and overgrazing.

III. — Description of the toxic effects produced by *Sarcobatus vermiculatus* ("Greasewood"), on stock, especially on sheep a Chenopodiaceae which is common in the States of Washington, Montana, California, Texas, on alkali soils. It appears that poison is due to sodium and potassium oxalates in the plant. This observation is of special interest, as it is usually considered that the poisonous principles of plants are of an alkaloidal or glucose nature. Soluble salts of calcium could be used as an antidote, but for a poison which affects animals so seriously there is probably no antidote which could be of practical use under range conditions.

IV. — *Sorghum exiguum*. — In Sèvre-Niortaise (France), a herd of cows showed signs of severe poisoning as a result of eating green sorghum which had been fed in the form of forage. The symptoms became so serious that some of the animals died within a few hours and the post mortem examination showed violent inflammation of the rumen the mucous lining of which had been removed in places where it had come in contact with fragments of the forage, as if it had been subjected to the action of some caustic substance. Two rabbits that had been given a few small stalks of sorghum in their rations died in a very short time. The toxicity of this sorghum would appear to be due to the presence of prussic acid in the form of a glucoside which is set free by the action of the digestive juices. This glucoside apparently occurs only in young plants whose development has been abnormal, for sorghums are as a rule, perfectly innocuous. This hypothesis is confirmed by the fact that Dr. SAUSSEAU, Director of the Veterinary Services of Deux-Sèvres, reported on the occasion of the above-mentioned poisoning of cattle that the sorghum used was badly developed

owing to the drought. A similar result was obtained by using sugar sorghum that had grown abnormally on account of adverse weather conditions.

M. L. Y.

674. The Early Detection of Pregnancy.

I. — SCHMIDT. (Tierzuchinstitut der Universität Göttingen). Über neuere Versuche zur frühzeitigen Feststellung der Trächtigkeit. *Journal für Landwirtschaft*, Vol. 71, Part I, pp. 1-8, Berlin, 1923.

II. — WENDT E. (Assistant, Göttingen). Die frühzeitige Trächtigkeitsnachweise bei Schweinen mittels. interferometrischen Methode. *Ibidem*, pp. 9-13.

III. — SAX A. (Assistant, Göttingen). Von welchen Zeitpunkt ab lässt sich die vorhandene Trächtigkeit bei Schweinen vermittelst der Interferometrischen Methode erkennen? *Ibidem*, pp. 14-15.

I. NEW METHODS OF DETERMINING THE EARLY STAGES OF PREGNANCY.

— Of the many methods for the detection of the beginning of pregnancy that have been brought forward as being a simplification of Abderhalden's seriological method, the most worthy of notice is HIRSCH's "interferometric method". This is carried out by means of an instrument called an interferometer made by the firm of ZEISS of Jena. The method is an optical one based on the principle that when the serum of a pregnant animal acts upon the tissues of the placenta, the insoluble albumin in the serum is decomposed by fermentive action into soluble peptones. The decomposition products pass into solution, thus raising the concentration of the serum which can be estimated by means of the interferometer, the value obtained being compared with that registered in the case of a similar sample of the same serum into which no placenta has been introduced. Preparations of placenta from different species of animal are supplied in a convenient form by the Pharmaceutical Institute of L. W. GANS, Aktiengesellschaft Obersel i. T.

When applied to human subjects, the interferometric system gives accurate results.

It has been widely used for animals, excellent results having been obtained with mares and sows, but since the properties of the placenta, and metabolism vary in the different species, it is necessary in every case to study whether the method can be usefully applied before finally adopting it.

As regards mares, it has been proved by results obtained from 110 animals that pregnancy can be satisfactorily detected by the interferometric method as early as 14 days after fertilisation. (GERMANN Über den frühzeitigen Trächtigkeitsnachweis bei Pferden nach der Interferometrischen Methode, *Landwirtschaftliche Jahrbücher*, Berlin, Parey, 1922).

II. EARLY DETERMINATION OF PREGNANCY IN SOWS BY THE INTERFEROMETRIC METHOD. — *Method*. From the results of his experiments on a hundred sows, the author concludes that: 1) a negative reaction is a certain

proof of the absence of pregnancy provided the animal had been served at least 4 weeks previously; 2) a positive reaction probably points to pregnancy, but is not an infallible criterion, for positive results are sometimes found in the case of non-pregnant sows, if they are in a pathological condition that allows non-specific ferments, usually digestive ferments, to find their way into the blood; 3) it is often possible to detect pregnancy in sows as soon as 8 days after they have been served but the protective ferments do not appear with any fixed regularity during the first 4 weeks after fertilisation: subsequent to that time, however, pregnancy can always be demonstrated.

III. HOW SOON IS IT POSSIBLE TO DETECT PREGNANCY IN SOWS BY MEANS OF THE INTERFEROMETRIC SYSTEM. — This article describes the continuation of the previous work. From experiments made with 61 serums taken from healthy, unmated sows and 59 serums obtained from sows that had been served, the author concludes that his investigations, like those of WENDT, have proved that with careful handling and proper material, few mistakes are made in diagnosing pregnancy in sows by means of the interferometric method, and that it is possible to detect pregnancy 2 or 3 weeks after fertilisation.

F. D.

675. Variations in Milk Yield (1).

I. — WILSON, J. The Variations of Milk Yield with the Cow's Age and the Length of the Lactation Period. *The Scientific Proceedings of the Royal Dublin Society*, Vol. XVIII, New Series, Nos. 11-13, pp. 97-104, figs. 2. Dublin, 1922.

II. — HAMMOND, J. (Institute of Animal Nutrition, School of Agriculture, Cambridge). Some Factors affecting Milk Yield. *The Journal of Agricultural Science*, Vol. XIII, Pt. 1, pp. 74-119, figs. 18, tables 19, bibliography. London, 1923.

III. — BROODY, S., RAGSDALE, A. C., TURNER, C. W. (Department of Dairy Husbandry, Missouri) Rate of Decline of Milk Secretion with the Advance of the Period of Lactation. *The Journal of General Physiology*, Vol. V, No. 4, pp. 441-444, figs. 1. Baltimore, 1923.

I. — *Variations of milk yield with the cow's age and length of the lactation period.* — The author reviews in succession: 1) the records obtained from cows exhibited at the London Dairy Show, during the 10-12 years prior to 1909; 2) scale constructed by GAVIN with reference to records kept in Lord Rayleigh's dairy herds in Essex (England); 3) scales constructed by PEARL, MINER, and TOCHER based on records published by the Scottish Milk Records Committee, relative to milk yields of Ayrshire cattle 1903-1912. The author considers that scales based upon the Ayrshire records cannot represent the normal daily rise in milk yield, and bases his conclusions on the two foregoing records:—

(1) Suppose that at 8 years old the cow yields approximately 67-80-90-95-98 to 100, for 4-5-6-7 year old cows.

(1) See R. 1922, No. 611 (Ed.)

(2) Insufficient information is as yet available for 2-year-old yields but those whose age averages about 2 ½ years should correspond to yields at 8-years-old, 50 to 100.

(3) For yields of cows over 8-years-old, records are also insufficient.

As regards milk yield during the lactation period, as the length of lactation varies, a scale is necessary to indicate how much should be added or subtracted to bring about a normal yield, i. e. successive calving after 12 months according to the Ayrshire reports for 1920, a lactation period of 11 months, indicates an average of 38 weeks milk yield; a period of 12-13-14-15 months corresponds to 40-44-45-47 weeks yield respectively. GAVIN found that the yields of cows which are in calf, begin to decrease (below those of cows which are not calving) about 24 weeks before the next calves are born. For a lactation period of 11 months the yields should be about 20 gallons below that for normal lactation, and for 13-14-15 months lactations, about 35, 65 and 90 gallons above that for normal lactation. The Ayrshire reports of 1913, 1919, and 1920 agree largely with the foregoing data.

II. — *Some factors affecting milk yield.* — The following factors were studied: 1) month of the year in which the cow calves; 2) length of the interval between calvings; 3) age, as measured by lactations; 4) dry period i. e. period of rest preceding the lactation under consideration.

Naturally, other factors also have an influence on the yield such as feeding, methods of treatment, methods of milking, weather, etc. In the hope of eliminating these influences as far as possible, the investigation was restricted to a single Milk Recording Society at Penrith (Cumberland and Westmoreland); all the cows were Shorthorns chiefly non-pedigree, and raised under similar conditions.

Effect of month of calving. — The information collected includes: 1) mean total yields of cows calving in different months (see Fig. I) as indicated by the curve; 2) mean length of lactation of cows calving in different months; 3) increase and decrease in yield in different months. The first curve indicates an increase in yield towards the end of May, the second an increase in milk yield from May or September followed by a decrease; the third, a decrease less marked in winter than in summer and autumn.

The decrease from June onwards is attributed to the fact that the pastures become dry and parched and the grass hard and fibrous, and in October when the fall is still more rapid, to the fact that the cow is adapting herself to winter conditions. This explains why as a general rule the yields are higher for cows calving in November. They are already used to winter conditions, — and they give a steady flow of milk which does not fall to any considerable extent until the following June or July. On the contrary a cow calving just before this winter change, yields less, probably due to the fact that the change occurs at a time when she is actively withdrawing from her body substances to supply the milk flow.

The period during which the milk falls rapidly (July) comes earlier in the lactation in November-February calvers, with the result that

yields are lowered. March calvers give their maximum when turned out to graze, so that they yield more during the first part of their lactation than the February calvers. It has been claimed that a good estimate of a cow's yield during lactation may be obtained by multiplying her highest daily yield by a given factor; the author's results do not, however, support this possibility.

Length of interval between successive calvings. — "Service period". This is on the average short in summer and long in winter (See Fig. 2). A study has been made as to the correlation between total lactation yield and service period. This is by no means a linear relation, the yield rising at first more rapidly and then more slowly as the interval is lengthened,

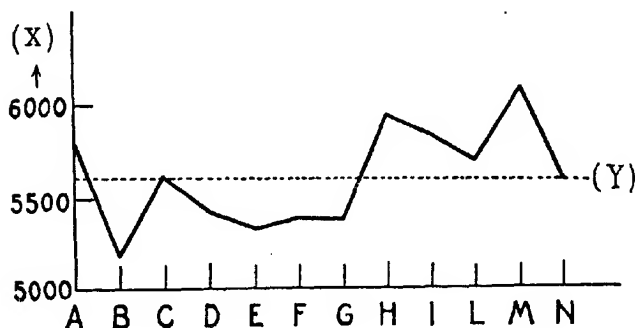


FIG. 109. — Mean total yields of cows calving in different months.

X = Yield in lb.

Y = Mean = 5607 lb.

Letters = Successive months of the year (January-December).

and apparently tending to a limit. This suggested that a curve might be drawn to calculate the effect of service period on total yield. As an example, a normal service of 100 days was selected as a standard. From the curve the mean total corresponding to this period = 5760 lb.

It will be noted that the yield may vary by as much as $\pm 30\%$ according to length of service period, due to the close relation between the length of this period and the length of lactation. As a result the authors endeavoured to ascertain the effect of foetal growth on the possible lowering of milk yield. The lower level is maintained for about 20 weeks when the cows begin definitely to dry off. The slight decrease immediately after service is probably due to natural cause resulting from the growth of the uterus and its contents. The definite drying off at 20 weeks after service may be attributed to internal secretions from the reproductive organs.

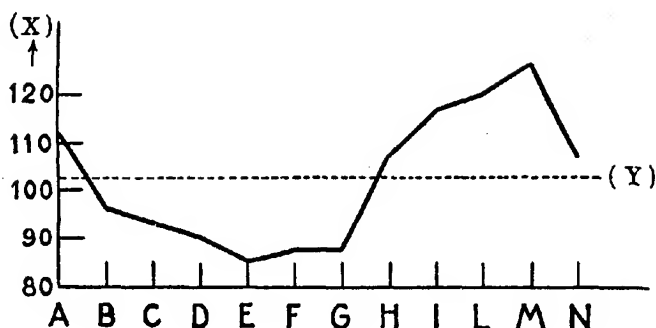


FIG. 110. — Mean service period of cows calving in different months.

X = Service Period in days.

Y = Mean = 102.3 day.

Letters indicate months January-December.

TABLE I. — Corrections to total yield for service period.
(Standard service period = 100 days).

Service Period	Mean total from cruvé	Percentage correction to apply
days	lb.	%
0-19	4427	+ 30
20-39	4770	+ 21
40-59	5084	+ 13
60-79	5372	+ 7
80-99	5635	+ 2
100-119	5876	— 2
120-139	6097	— 6
140-159	6300	— 9
160-179	6485	— 11
180-199	6655	— 13
200-219	6830	— 15
220-239	6952	— 17
240-259	7083	— 19
260-279	7202	— 20
280-299	7311	— 21
300-319	7411	— 22
320-339	7503	— 23
340-359	7587	— 24
360-379	7664	— 25
380-399	7734	— 26
400-419	7799	— 26
420-439	7858	— 27
440-459	7912	— 27
460-479	7961	— 28
480-499	8007	— 28

Age. — Firstly a study was made as to effect of age on the length of the service periods, which are evidently shorter with age until after the third or fourth calf, when an increase in length has been noted and after the sixth or seventh calf it is longer than after the first. Consequently no accurate measures have been obtainable as to the variation which a cow's yield undergoes as she becomes older, without first correcting her total yield for the corresponding service periods. Accordingly, the authors first corrected all totals for the month of calving and for the service period; then the means of the first and second lactation totals of all cows were found and the difference expressed as a percentage of the first lactation mean total. The percentage of the second and third lactation was calculated in the same way. The results for the first six lactations are shown in the following table:

TABLE II.

Lactation period	Mean table (corrected)	Rise or fall
	1st	%
1st lactation	4909	+ 10.5 % \pm 1.8 %
2nd "	5425	
	5746	+ 10.7 % \pm 2.0 %
3rd "	6359	
	6595	+ 0.2 % \pm 2.2 %
4th "	6610	
	6655	+ 6.5 % \pm 2.7 %
5th "	7088	
	7782	- 5.4 %
6th "	7364	

Taking an average 1st lactation yield as 4 909 lb., the 2nd yield is calculated as 110.5 % of this; the 3rd is 122.2 % of the first; the 4th 122.5 % and the 5th 130.3 %. The corrections for age to estimate 5th lactation period is given as 30 % (1st lactation); 18 % (2nd); 10 % (3rd), 4 % (4th).

The mean totals obtained for different months of calving are considerably influenced by the ages of cows as well as by the service period. The authors calculated in this way the total mean yield for all the cows (5 607 lb.); and the monthly mean yield, corrected for service period and age, and separate corrections as regards month of calving and service period: — the corrections for month of calving are expressed as follows: January —; February +10 %; March +2 %; April +3 %; May

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+2 %; June and July —; August —8 %; September —4 %; October —1 %; November —6 %; December +2 %.

The rest, or dry period, is not effected by age, hence corrections are not considered necessary.

Length of dry period. — To obtain an accurate measure of the effect of the dry period on the subsequent yield, corrections were necessary for the totals for service period, age (a short dry period generally corresponds with a long service period); month of calving. Subsequent yields were then expressed as a \pm percentage of the 1st lactation yield, with a view so establishing the correlation between these percentages and the length of the dry periods. The mean percentage yield corresponding to a dry period of 0-39 days, was 100.0, for 40-79 days, 110.9, and 114.2 for 80-119 days. It appears, therefore, that a cow's yield is considerably lowered by a very short dry period, but not greatly increased by a very long period. The mean length of the dry period of all lactations was 85 days; there is, however, some evidence of a further rise associated with dry periods of over 120 days, correction to apply = -2 %; 40-79 days, +2.5 %; 0-39 days +13 %.

The problem was also attacked by another method: the totals given by the same cow after dry periods falling in the above categories were compared. The mean of all the yields was found and the variation of the cow's several totals expressed as \pm percentage of this individual mean.

Conclusions. — The figures obtained from a lactation by applying the above corrections is an estimate of the cow's yield, under normal conditions when at her prime (at the 5th or 6th calf), that is to say, calving in January, June or July (i. e. mean months); with a period of 100 days between successive calvings; with an 85 days period of rest before calving.

The variation is allowed for by applying corrections to the extent of 20 % of the original value; 3 % for service period and month of calving; 15 % for age; 2 % for dry period. It should be noted, however, that this does not give a good idea of the relative value of these corrections as cows tend to have all long or all short service periods and this applies also to dry periods. Cows also, generally calve about the same time each year. In this way it is considered probable that the average maximum variations are due to four factors, e. g. for a 7000 lb. cow: service period 4074 lb.; age 1615 lb.; month of calving 1245 lb.; dry period 948 lb. Fig. III gives an idea of a definite approach to the real milk producing capacity of cows, after making corrections. The distribution of the variation of corrected totals is much more regular than that of the uncorrected, and the number of lactations shows an increase of 27.3 %.

The authors review, in closing, the experiments made by other investigators.

III. — *Decline of milk secretion with the advance of the lactation period.* — In order to understand the nature of the decline of milk secretion with the advance of the period of lactation, the authors have compared the curves of the decline of production of milk and the period of lactation found in

the Holstein, Jersey, Guernsey and scrub cows, with a curve based on a formula expressing the course of certain chemical reactions, and found them to be in close agreement. The decline of milk secretion may thus be

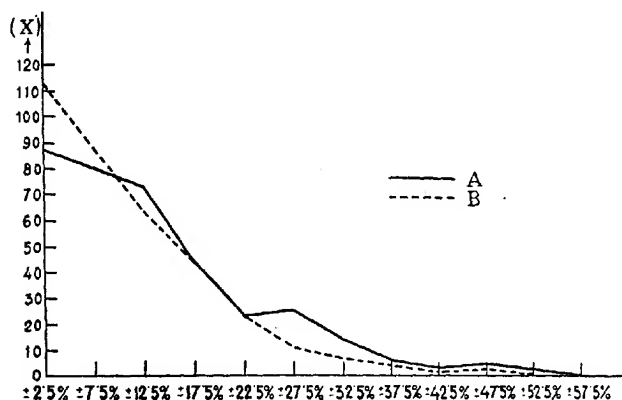


FIG. 111. — Frequency curve of percentage deviation of totals from individual means.

X = Frequency. Y = Percentage deviation (mid values of intervals).
 — A (uncorrected totals).
 - - - B (corrected totals).

represented by the equation of a monomolecular chemical reaction, which is constant throughout the lactation period. This suggests that milk secretion is limited by a chemical reaction and that the speed of the lactation process is controlled by the concentration of a limiting substance.
 F. S.

676. Egg Production of the Various Periods of the Year and Classification of Laying Hens (1).

I. — HARRIS J. A. and LEWIS, H. R. (Station for Experimental Evolution, Cold Spring Harbor, Long Island, New York). The Winter Cycle in the Fowl. *Science*, Vol. LVI, No. 1443, pp. 230-231. Utica, N. Y. 1922.

II. — HARRIS, J. A. and GODDALE, H. D. (Massachusetts Agricultural Experimental Station, Amherst, Mass.) The Correlation between the Egg Production of the various Periods of the Year in the Rhode Island Red Breed of Domestic Fowl. *Genetics*, Vol. 7, No. 5, pp. 446-465, diag. 7, bibliography. Brooklyn, New York, 1922.

(1) See R. 1919, No 960 (Ed.)

III. — PAYNE, L. F. Culling Farm Poultry. *Agricultural Experiment Station Kansas State Agricultural College, Department of Poultry Husbandry Circular* 93, pp. 1-33, figs. 23, bibliography. Manhattan (Kansas), 1922.

IV. — CALDERON, B. Le classement des poules pondeuses d'après leurs caractères anatomiques et physiologiques. *La Revue Avicole*, 33rd Year, No. 1, pp. 9-11, figs. 2. Paris, 1923.

I. CORRELATION BETWEEN THE EGG PRODUCTION OF THE VARIOUS PERIODS OF THE YEAR IN THE WHITE LEGHORN BREED OF DOMESTIC FOWL — Part of a series of investigations in connection with egg records and laying breeds.

The idea of the superimposition of a Mendelian factor or factors determining the egg production of the "winter cycle" upon the factors determining the egg production of the normal or reproductive cycle has become recognised as an explanation of the inheritance of fecundity in the domestic fowl. In recent years there has been much scepticism among breeders as to the truth of this hypothesis. Definite evidence for or against is difficult to obtain.

Some light may be thrown upon the problems by the determination of the correlations between the egg records of the various "cycles" in the first and second laying year. If the birds of a flock differ fundamentally among themselves, by reason of the presence or absence from the zygotes from which they developed in Mendelian genes or factors determining their winter egg production, it would be logical to expect that the highest interannual correlation would be that of the winter period. This should be true under the theory stated unless the further assumption be made that genes of factors which determine egg production during the "winter cycle" of the first laying year have no influence in determining production during the "winter cycle" of the second laying year.

The authors have, therefore, studied all possible correlations between the total egg records of the "cycles" of the first and second year for a series of 443 White Leghorn birds for which complete records for the first two laying years are available. These correlations are shown in the accompanying table. The conventional limits of these cycles are as follows: spring, March to May; summer, June to August; autumn, September to October; winter, November to February.

Correlations indicate that for all the four periods considered, there is a higher correlation between the records of homologous periods than between those which are not homologous; for example, the correlation between the "winter cycle" first and second years is 0.3225 ± 0.0301 ; between the "winter cycle" first year and the spring cycle, first year, $+0.0680 \pm 0.0335$; between the "winter cycle" first year and the spring cycle, second year $+0.1177 \pm 0.0332$ etc. They show also that the correlation between the winter periods of the first and second year is the lowest of any of the four correlations between the productions of homologous periods ($+0.3293 \pm 0.0300$; $+0.4272 \pm 0.0275$; $+0.5545 \pm 0.0233$ for winter cycle", summer and autumn). The difference be-

tween the winter-winter correlation and the spring-spring correlation is not great, but the differences between the winter-winter correlation and the summer-summer and autumn-autumn coefficients are more substantial, the latter being 2.57 and 6.10, as large as their probable error.

As far as this form of evidence relates to the problem, it indicates that in the White Leghorn at least, there is no evidence of special factors which distinguish the "winter cycle" from any other period of the year.

II. CORRELATION BETWEEN THE EGG PRODUCTION OF THE PERIODS OF THE YEAR IN THE RHODE ISLAND RED BREED OF FOWL. — Results of a statistical analysis of the monthly egg records for the pullet year of 1658 Rhode Island Reds at the Massachusetts Agricultural Experiment Station, Amherst (Mass.). This study forms part of a series of investigations on the more important laying breeds (1).

The problems under consideration and the results obtained are summarised as follows:

1) *Correlation between monthly record and total annual production.* — Coefficients are shown to have a material positive value ranging from 0.325 to 0.634 in the 36 determinations made: the average values were: $r = 0.5094$ (1915-16); $r = 0.5479$ (1916-17); $r = 0.5363$ (1917-18).

The production in the case of the White Leghorn may be calculated on the same basis. The regression for the annual total egg production is roughly speaking linear. The constants indicate therefore that the production of any individual months should furnish a reasonably satisfactory basis for the prediction of egg production for one month, using equations of the type computed and shown to be effective in the case of White Leghorns.

2) *Correlation between the record of individual months and of the other eleven months in the same year.* — These values are lower than those deduced for the relationship between monthly production and annual production. This is clearly shown by the statistics.

Apparently the correlation between the individual months of the year and the annual total is not due primarily to the inclusion of the record of the individual month in the annual total.

3) *Correlation between the annual production and the deviation of the productions of the individual months from their probable values.* — These correlations refer to two year periods and to the combined period 1912-19. The average is as follows: $r = 0.196$ (1915-16) $r = 0.244$ (1916-17); $r = 0.228$ (1912-19). The coefficients for the different permutations vary considerably; for instance a correlation of 0.918 exists between the 1915-16, and the 1916-17 coefficients. Two systems of coefficients appear to exist:

1) The correlation between the egg production of the individual months tends to become smaller as the interval between the months considered is widened.

2) There is a more intimate correlation between the egg production of the autumn and winter months at the beginning and end of the contest year, than between the egg production of these months and that

of the spring and summer months. These two laws of the distribution of the magnitude of the correlations are to some extent mutually obscurant.

These conclusions are in general agreement with those already drawn for White Leghorns.

III. CULLING FARM POULTRY. — The use of trap-nests is the only sure means to ascertain the individual egg-production of fowls, but these nests entail a good deal of labour and cost both money and time, hence they are not every practical for a farm, although by their means it has been possible to determine the correlation between various degrees of production and certain characters, thus enabling the poultry-breeder to distinguish with a fair amount of accuracy, if not with the certainty gained by the employment of trap-nests, the good, average, and bad layers of his flock. He has, however, no guarantee for the future egg-production of the hens, except in so far as it may be predicted from their past performance. No reliable method has yet been devised for the estimation of the egg-yield of young pullets that have not begun to lay.

Classification must therefore commence with egg-production. In the United States, the hens are examined once a month from about the middle of July to the middle of October. In July and August, the bad layers are eliminated, while in September and October, the best individuals are selected for breeding purposes. Amongst the good layers, it is necessary to distinguish between the hens that will only lay a large number of eggs the first season and those birds capable of a sustained effort for several years.

Present production. — Information as to present production can be obtained by examining the cloaca, the bones of the pubis, the comb, wattles, and ear-lobes. The cloaca of a laying hen is large, moist and dilated with a tendency to assume an ovoid shape. The lower border is flat and the upper one is merged into the surrounding issues (See Plate XXXIII, Fig. 112-A). The cloaca of a hen that does not lay, or is a bad layer, is on the other hand, small, contracted and dry (See Fig. 112-B). In a laying hen, the bones of the pubis are at least two finger breadths apart, which is the maximum distance found in a hen that does not lay. The comb is one of the best characters for distinguishing the layers from the non-layers in the poultry-yard. The wattles and ear-lobes are also useful, but not to the same extent. When the egg-producing apparatus is developing and is in activity, the blood circulates more freely in the comb, wattles and ear-lobes, so that they become larger, more glossy and appear fuller. As soon as egg-production slackens, these appendages change their appearance, and when egg-laying ceases the comb becomes small, shrivelled and dry; further it is generally covered with a white film and is cold, which shows that the blood circulates very slowly.

Duration of laying period. — The duration of the laying period can be estimated to a large extent by the colour of the hens skin and the beginning of moulting. The yellow pigment (xanthophyll) seen in the beak and legs of a hen is the same as that found in the yolk of the egg. When a hen does not lay, the yellow pigment is localised in the body tissues and

is frequently met with in the cloaca, the eyelids, ear-lobes (if these are usually white), beak and legs of the bird, but as soon as the hen begins laying, this colouring matter is absorbed in egg-formation and leaves the parts of the body where it was visible before, so that these become whitish.

When a hen with yellow skin commences laying, the xanthophyll leaves the cloaca from which it disappears at the end of a few days. The turn of the ear-lobes comes next, they lose their cream-colour as does also the beak. The colour gradually leaves the commissure of the beaks, the tip of the beak being the last place from which it disappears. After 4 to 6 weeks of egg-laying, the yellow colour has entirely disappeared from the beak and the legs are the last to lose their pigment. This decoloration begins in front and finishes beneath the feathers, behind the tibio-tarsal joint. The process is not complete until after the 4th or 5th month of egg-production. The change in colour is affected by food, the size and age of the bird, the texture of its skin, its vitality and the extent of the pigmented area in the individual and the family to which the hen belongs. The decoloration is more important for classification during the period preceding April 1. The following breeds are classified according to the rapidity with which the yellow pigment disappears: Leghorn, Wyandotte, Plymouth Rock and Rhode Island Red.

In white plumaged fowls and also in some others, the duration of egg-laying can also be estimated from the condition of their feathers in summer and autumn. As long as a hen is laying regularly she keeps her old feathers, but when she ceases laying owing to her becoming broody, or ill, the moult sets in and extends from the neck to the back, wings, and other parts of the body. The neck of even the best layer may at any time become bare of feathers, but the moult does not extend over the rest of the body until egg-laying has ceased. Thus, it may be said that the later a hen begins to moult, the longer her productive period lasts and the more eggs she will lay, whereas a fowl that begins to moult early has probably made a poor record.

Intensity of production. — In order to be a good layer, a hen must not only produce eggs for many weeks, but must lay 5 to 6 eggs a week.

The intensity of production can be gauged from the capacity of the body, state of the abdomen and quality of the skin. (See Plate XXXIII, Fig. 113). It appears that a hen in full egg-laying should have an ovary and oviduct about 20 times as large as those of a hen that is not laying; the appetite of the laying bird is also larger and its digestive apparatus is more developed.

Capacity for egg-laying is shown by the distance between the front of the breast-bone and the centre of the back, by the space between the posterior end of the breast-bone and the bones of the pubis, by the length and width of the back and by the length and width of the breast-bone. These dimensions are more or less fixed in the adult hen, except that the posterior part of the breast-bone rises, or sinks. A space of 4 to 5 finger-breadths between this portion of the breast-bone and the

bones of the pubis generally indicates a good layer. The position of the breast-bone in relation to the line of the back may also be taken into account, and is judged by placing one hand on the back and the other on the breast-bone. This test is only applicable to laying fowls; the capacity of pullets that have not reached the period of egg-production must be estimated from other measurements.

The abdomen of a good layer is not only full and capacious, but should also be soft and flexible; the fat should not be hard. The capacity of the abdomen depends upon the size of the hen and the length of her breast-bone; usually, a long breast-bone is preferred. The bones of the pubis should be thin and supple, they are only thick and covered with hard fat in the case of birds producing few eggs. In addition, good layers have a soft, oily, thin skin.

The reproductive organs of a broody hen rapidly shrink in size, the bird loses its appetite and the cloaca, as well as the whole abdominal region, tends to contract. At this time, while retaining the characters of birds that have laid much, broody hens have an abdomen of average size, and the cloaca, although fairly large, is dry and is surrounded by large folds. The brows are thick and over-hanging, the head, comb and wattle are dull in colour.

At other times besides the egg-laying period, it is possible to distinguish laying hens of the "productive type", which type is characterised by the great depth between the front part of the breast-bone and the centre of the back; the deep thighs narrowing off into a wedge-shape; the long, straight back of equal width to the base of the tail; the broad pelvis and wide expanded breast.

The author, after mentioning the various causes that may affect the above-mentioned characters and thus mislead the breeder who is using them as a basis of classification, passes on to examine the cock, which must be vigorous and should possess a short, well-curved beak, a large, deep comb and bright, quick, prominent eyes. Its comb, cheeks and wattles ought to be of a fine red, the neck short, arched and well-set on the shoulders. The legs of medium length are straight and the tibio-tarsal joints are far apart. The breast is prominent, the shoulders far apart; there should be a great width between the middle of the back and the centre of the breast-bone. Contrary to what is required in the hen, in the well-bred cock there should be little distance between the bones of the pubis and the abdomen ought to be small. It is not advisable to choose early-maturing cockerels, since their skeleton is often weak, and they are frequently under-sized. Breeding from too young cocks tends to decrease the size of the progeny and may even affect the size of the eggs.

After some experience, the breeder who bases his selection on these data and on present production should attain 95-100 % of accuracy. If the birds are classified according to their annual production estimated from the records of former years, the degree of accuracy will only be 70 or 75 %.

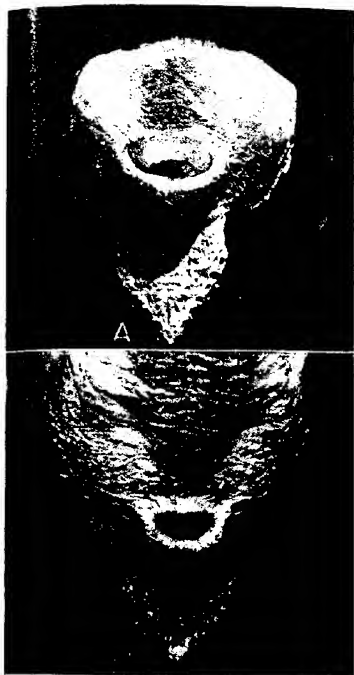


FIG. 112. — The vent and abdomen of a laying hen (A) and of a nonlaying hen (B).



FIG. 113. — The contracted abdomen and contracted deeply-wrinkled vent of a hen 9 days after going broody.

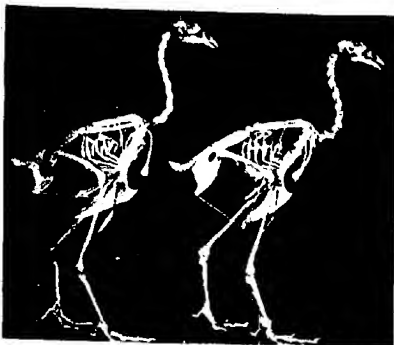


FIG. 114. — Skeletons of the cull (left) and the high producer (right). When judging body type of good hens that are *not* laying, emphasis is placed on the size of the triangle (left) and that of the triangle (right) representing hens in *full* production. When a hen stops laying, the right base of the triangle (right) moves towards the left base so this distance varies with egg production. The similar points of the triangle (left) remain the same whether the hen is laying or not.



FIG. 115. — Hip bone seen from above and behind, without the tail vertebrae: *a, b, c, d*, lumbar and sacral vertebrae; *e, f*, extremities of ischium, *g, h*, extremities of pubis.

IV. THE CLASSIFICATION OF LAYING HENS ACCORDING TO THEIR ANATOMICAL AND PHYSIOLOGICAL CHARACTERS. — The measurement of the distance between the bones is an uncertain method of estimating abdominal capacity, for the pelvic bones yield easily to the pressure of the fingers and further, these bones may themselves vary in width. The pelvis of the adult birds is formed by the fusion of the ilium, ischium and pubis; it does not assume its definitive shape until the hen is ready to lay, therefore any measurements taken before that time can give no accurate information. The size and weight of the bird depend to a large extent upon the development of the pelvis, but its weight is more a function of the width than of the length of the pelvis. In a fat hen, the dimensions *i-j* and *e-f* are relatively very large, as are also *a-b* and *c-d* (Plate XXXIII, Fig. 115). The dimensions *i-j* can easily be estimated in a live fowl and give a good idea of the width of the pelvis, even before the bird begins to lay. With the approach of the laying season the apertures *e-f* and *g-h* become greatly enlarged, but it must be noted that the space *g-h* is relatively smaller in a large than in a small hen, especially if the small hen lays large eggs. In large hens, the sternum is wider and its lateral processes (apophyses) are further apart and give more width to the abdomen. These processes are very flexible, and the whole sternum moves easily in an upward direction under the pressure of the intestines. The author has also noticed that the characters distinguishing a good layer are more noticeable in a small hen than in a large one.

On comparing the pelvic bones of the two birds, he has come to the following conclusions.

- 1) The narrow skeleton of the small hen may indicate a poor layer, or a prolific layer of small-sized eggs.
- 2) A hen with a fine pelvis may be a good, or a bad, layer.
- 3) A hen with an average pelvis may lay 250 eggs during its first year of laying.

The indications are that selection, directed to increasing the abdominal capacity, would control the tendency of prolific layers to produce small eggs.

F. S.

General.

677. The Licking Habit and its Connection with Forage Composition (1).

KÖNIG J. and KARST H. (Landwirtschaftliche Versuchstation, Münster i. W.) Der Einfluss des Bodens und der Düngung auf die Zusammensetzung der Pflanzen. Ein Beitrag zur Geschichte der Lecksucht. *Die landwirtschaftlichen Versuchs-Stationen*, Vol. C, Part VI, pp. 269-315. Berlin, 1923.

The authors have carried out researches at the Agricultural Experiment Station of Münster (Germany) to ascertain the effect of soils and fertilisers upon plant composition and the connection between the composition of forage and the licking habit in calves.

(1) See R. 1921, No. 1132. (Ed.)

It is now generally admitted that the cause of this habit is to be sought in forage and especially in hay, therefore the authors have compared the composition of the various crops in localities where this disease was unknown with that of the same crops in localities where the licking habit was prevalent (Hollich, near Burgsteinfurt i. W.).

No important difference was discovered in the ordinary forages (rye, oats, straw, potatoes, beets) grown on the various soils, but there was a considerable difference in the composition of the hay. In the sand-free dry matter of the hay samples from Hollich the following percentages were found: crude fibre 33.11 to 36.49; silicic acid 0.44 to 0.645; phosphates 0.0307 to 0.046; soda 0.091 to 0.107; ratio of phosphoric acid to calcium oxide 100:155 to 100:187; as against 29.58 to 31.22 — 1.87 to 2.65 — 0.0426 to 0.0562 — 0.277 to 0.589 — 100:203 to 100.249 respectively for hays from three localities where the licking habit had never been observed.

OSTERTAG and ZUNTZ's first suggestion that there was some toxic principle present in the hay causing licking disease, can be rejected, since the disease has been proved to be accompanied by affections of the bony framework due to a lack of bone-forming substances in the food supplied to the animals.

SOXHLET and Fr. FLEISCHMANN have assumed that an insufficiency of phosphates is the cause of the disease. The analyses of our authors have, it is true, shown the hay of infected districts to contain less phosphates than that of good farms where the disease has never made its appearance, but the differences in the phosphate content were very small.

IBELE attributes the licking habit to an insufficiency of soda in the hay (which may be accompanied by an increase in the potash content), and to a wrong proportion between sulphuric acid and lime, leading to loss of lime in the animal organism. The Hollich hay did, indeed, contain little soda and a defective sulphuric acid:lime ratio, but this does not appear to account entirely for the disease which cannot be cured by merely giving the animals kitchen salt and calcium carbonate, whereas linseed cake has proved an efficient remedy.

In HOLY's opinion, licking is caused by the presence in the hay of too large proportions of silicified, crude fibre which injures the mucous membrane of the intestine thus decreasing the utilisation not only of the hay, but also of the other foods. This hypothesis may, however, be rejected, for although the Hollich hay contained more crude fibre than the hays from the other districts, its silica content was lower.

E. RITTER attributed the licking habit observed in Switzerland among dairy cows to the low alkalinity of the hay and its higher phosphoric acid content as compared with the lime. This, however, cannot in itself be the cause of the disease, for although the Hollich hay contained more potash and soda than good hays, the alkalinity of its ash is about the same.

M. POPP has found that the ash of the blood of animals attacked by the licking disease is richer in potash and poorer in soda than the

ash of healthy animals. The authors thinking a similar difference might exist in the milk examined it, but without any conclusive results. From the data they collected, it is, however, certain that the offspring of cows fed on abnormal hay are born with a predisposition to the licking disease.

Hays from acid meadows, which include those suspected of being the cause of the licking disease, have an unpleasant odour due to the presence of a special volatile acid; the concentration of hydrogen ions in the aqueous solution of these hays is higher than in that of wholesome hay. J. KÖNIG considers this property and the higher content of crude fibre to be the causes of the low availability and poor nutritive value of hay from acid meadows. This would account for the fact that these hays when treated with steam are more readily eaten by cattle, and according to OSTERTAG and ZUNTZ are perfectly harmless. Thus, the reason of licking disease making its appearance as a result of the cattle being fed upon a certain quality of hay is not the insufficiency, or excess, of any single constituent, but is certainly to be found in the co-operation of several injurious factors. In all the cases hitherto reported, the suspected hay came from new soil, or acid, peaty land, poor in bacterial flora owing to a more or less one-sided application of mineral fertilisers. After some years of cultivation, such soils become normal.

Remedial measures: treat suspected hay with steam, and make all the grass of suspected meadows into sweet silage, further, give a complementary ration of cake and a little molasses feed, or else salt and lime.

As regards the effect upon the composition of cultivated plants by the character of the soil, it is chiefly noticeable in the alkalinity of the ash, but its degree varies greatly with the species. This was again confirmed by the work of the authors.

In cereals, the grain is negatively alkaline, while the straw is positively alkaline. The degree of negative alkalinity of the grain varies in the different species, but remains fairly constant within the same species, therefore it is not affected by the soil, or the application of fertilisers. Straw, on the other hand, is positively alkaline when the soil is alkaline, or has been limed.

It has often been proved that in cereals, as well as in roots and forage, there exists a correlation between the amount of potash and of phosphoric acid present in the ash, so that the alkalinity of the ash is highest when the potash content is greatest, and the ratio between potash and phosphoric acid is widest.

F. D.

678. *Lamium amplexicaule* and *Malva parviflora* Cause of Staggers or Shivers of Livestock in New South Wales.

DODD, S. (Lecturer in Veterinary Pathology and Bacteriology, University of Sydney) and HENRY, M. (Government Veterinary Surgeon). *Department of Agriculture, New South Wales, Science Bulletin* No. 23, pp. 1-24. Sydney, 1923.

Investigations made with sheep affected by "staggers" or "shivers", caused by the enzootic disease occurring also amongst horses, cattle and

sheep in certain parts of New South Wales viz. the alluvial areas of the basin of the Namoi River, and of the Gwydir River. This disease is characterised by the intoxication of the central nervous system, which has been observed to be caused by ingestion of certain plants, especially *Malva parviflora* and *Lamium amplexicaule*. No definite structural alterations have been noted histologically, likely to incite permanent damage to nerve tissues; this is evident from the fact that sheep removed from pastures where these plants are known to be growing, have been reported to recover rapidly and completely.

It has not been definitely shown whether the toxic principle exists actually in the plant itself or is due to fungi or other parasites in the plants. It should be noted, however, that at the young green stage the toxin is not fixed and a few days after the plant has been cut, the toxin has largely disappeared. As the plant matures, the toxin becomes fixed, and is more virulent in the case of *Lamium amplexicaule* than with *Malva parviflora*.

Sheep are very subject to attack and it is considered probable that the toxic principle is transmitted in the mother's milk without the mother showing any symptom of "staggers".

Attention is drawn to a letter in the *American Veterinary Review*, Vol. XXX, p. 106 (1906) by S. H. HESTER, Veterinary Surgeon, Santa Barbara, California, headed "Injurious Effects of Malva Plant", which appears to deal with a condition identical to that studied by the authors.

G. Tg.

679. The Dog As a Carrier of *Boophilus microplus*.

CASSAMAGNACHI O. El perro come vector de *Boophilus microplus* *Revista de la Asociación rural del Uruguay*, Year LII, No. 3, pp. 59-61. Montevideo, 1923.

The author describes four experiments made with dogs. The animals were a fox-terrier, a short-haired "galgo", a large long-haired, curly-coated mongrel pointer, and a long-haired Maltese terrier. The conclusions he reached were as follows: 1) dogs act as hosts, not only to *Amblyomma maculatum* but also to *Boophilus microplus* which lives upon them and thrives; 2) the female *Boophilus* that develops upon the dog lays fertile eggs; 3) the larvae when they hatch out attach themselves to cattle on which animals they probably accomplish their biological cycle; 4) short-haired dogs are able to get rid of these parasites which can only establish themselves on dogs with long thick coats.

J. P. C.

680. Haemoglobinuria of Cattle.

SANZ, B., and SKIBA, O. La hemoglobinuria bovina. *Boletín de la Sociedad nacional de agricultura*, Vol. LIV, No. 7, pp. 430-433, tables 1. Santiago, Chili, 1923.

The author during the investigations made as to the cause of haemoglobinuria of cattle have succeeded in reproducing this disease in pigeons and guinea pigs. Intramuscular injections were made with various sam-

ples of urine from diseased foals. Results obtained were definite; the animals died on the sixth day.

During the autopsy of the infected animals, microscopic examination was made. The anaerobic cultures obtained with minute portions of liver showed the presence of a bacteria, type *Clostridium Welchii*, and other organisms (*coli* and *subtilis*). Further injections and cultures gave a colony of *Cl. Welchii* which when injected into a calf produced the disease immediately, with fatal consequences.

From these experiments the authors have concluded that haemoglobinuria is an infectious disease connected with the digestive organs and caused by a bacteria of the type *Clostridium Welchii*, which attacks the liver. In addition, the disease may be induced by intrahypatic inoculation.

J. P. C.

681. Artificial Feeding and Lack of Vitamines.

HOET, J. (Laboratoire de Chimie Physiologique de l'Université de Louvain). Étude de l'alimentation artificielle chez le pigeon et de la déficience en vitamines. *The Biochemical Journal*, Vol. XVII, No. 2, pp. 220-229, graphs 2, tables 1, bibliography. Cambridge.

Experimental tests were made with pigeons fed on a ration composed of 18 parts casein + 60 rice + 4 McCollum salts + 3 filter paper + 10 margarine + 5 butter, with a supplement of yeast or other water soluble vitamine to replace the deficiency in vitamine B. This ration was sufficient to maintain normal health and the reproduction processes and cross-breeding with the offspring. The dry yeast supplement acted as a preventative against polyneuritis and to conserve the normal weight. The usual minimum dose for this purpose lies between 0.80 and 0.90 gm. for pigeons of 350-400 gm. weight. For pigeons in a state of collapse, with convulsions, a daily dose of 0.60 gm. of yeast is sufficient to relieve these nervous attacks after a few hours and subsequently to induce an increase in weight. The egg-laying level is, however, not so easily regulated and never attains the normal.

As regards liposoluble vitamines, the authors were faced: firstly with the difficulty in purifying the feeds, and secondly the slowness with which the animals responded to the deficiency in vitamine A. The experiments made with pigeons indicated that for poultry, in any case for adults, the liposoluble vitamine is unnecessary. This is directly opposed to the results obtained with chickens tested under similar conditions by HART, HALPIN and STEENBOCK (1922), EMMETT and PEACOCK (1922) and PLIMMER and ROSEDALE (1922) and others. The authors undertook further tests using for ration, 18 parts casein + 60 starch + 15 groundnut oil + 4 salts + 3 filter paper. The oil was solidified by hydrogenation (hardened fat), and was lacking in vitamine. Control tests were made with four young rats and symptoms of xerophthalmia were observed shortly after.

G. Tg.

[681]

682. The Feeding Value of Oat Straw.

COLLINS, S. H. (Agricultural Department, Armstrong College) *The Journal of the Ministry of Agriculture*, Vol. XXIX, No. 11, pp. 993-997, bibliography. London, 1923.

Experiments have been carried out since 1920 at Armstrong College, Newcastle-upon Tyne (England), with the twofold object of determining the effect of natural causes in producing variations, in the feeding value of oats, and of discovering the conditions necessary for the production of straw with a high nutritive value.

Starch is the principal carbohydrate found in straw and all the nitrogenous substances present are of great importance, since the proportion of non-albuminoid nitrogenous matters is very low.

An analysis of the straw harvested in 1919, 1920 and 1921, gave some indication of the effect of fertilisers on the feeding value of oat-straw. When a large amount of organic nitrogenous manure was used, the albuminoid content of the straw was 1.27 % higher than if very little of this fertiliser had been applied or none at all, and 1.30 % higher than that obtained with a top-dressing of sulphate of ammonia. As a rule, oat straw with a 1.28 % higher albuminoid content is obtained from the use of a large quantity of an organic nitrogenous manure than by the application of any other fertiliser.

On the other hand, it is probable that organic nitrogenous fertilisers decrease the amount of levulose in oat-straw, and that from the point of view of sugar production, sulphate of ammonia is superior to organic nitrogen. By ploughing up an old field of thick clover, or applying a liberal dressing of stable-manure, the albuminoid or meat-forming substances in straw can be increased until they are 1.5 times higher than in the case of straw grown on badly cultivated land, but the proportion is reversed as regards the sugar content.

The author has also studied the connection between the variations in the albuminoid content of the straw and geographical position, and states that the albuminoid substances increase the further north the oat-crop is cultivated. This may be explained to some extent by the fact that, as the vegetative period is shorter, there is less time for the grain to abstract as large an amount of nutritive substances from the straw as in the south, but it is equally possible that the difference in rainfall may have some influence.

In order to have a high sugar content, it is necessary to have fine weather at harvest time. When it is dry, the straw loses little of its sugar, but in wet weather, the sugar content is greatly reduced.

The albuminoid and sugar percentages varied from 1.1 % — 8 %, and from 0.3 % — 9.7 % respectively, that is to say, good quality oat-straw may have a higher feeding value than poor hay.

F. S.

683. Digestion Experiments with Bullocks fed on Paddy Straw.

WARTH, F. J. (Agricultural Research Institute, Pusa). *The Agricultural Journal of India*, Vol. XVIII, Pt. V, pp. 456-464, tables 5. Calcutta, 1923.

Experiments made at Pusa (India) with two bullocks fed for 10 months on a ration consisting of paddy straw combined with a small amount of concentrates. No green food was given. The average live weights of the animals were in the proportion of 1 : 1.40 and the food given, 1 : 1.25.

The average digestion coefficients obtained from the two animals indicated that the animals were able to utilise the food to a very satisfactory extent. Of the organic matter, nearly 60 % was digested. Figures as a whole show that small differences in the nitrogen content of the paddy straw may be expected to produce distinct differences in feeding results. The nutritive ratio of digested food averaged 1 : 16.2. The figures relative to the digestion of nitrogen in relation to the straw composition (which was found to contain an average of 0.5 % nitrogen) confirms the above statement. It appears that from 12-15 gm. is the minimum quantity required to maintain a nitrogen balance in animals of from 500-700 lb. weight. The greatest amount which the animals were able to assimilate from the straw was 4 gm. and the addition of a concentrate is therefore essential. By using good straw the concentrate, may, however, be reduced by one-half.

M. L. Y.

684. White versus Yellow Maize; Relative Feeding Values.

BLACKSHAW, G. N. (Chief Chemist, Department of Agriculture, Rhodesia). *The Rhodesian Agricultural Journal*, Vol. XX, No. 2, pp. 178-182 and Bulletin No. 455. Salisbury, April 1923.

For some time the Rhodesian Government Agriculturist has recommended the cultivation of white dent maize in preference to the yellow dent varieties and flint maize. The author mentions certain facts which support this claim, and discusses in detail the relative feeding values and market estimates, compared with the Argentina La Plata small flint maize.

It appears that the quantity of the fat soluble vitamine A in yellow maize is not sufficient to supply the animal, fed at normal rates, with the required amount, and an adequate substitute is necessary. According to HENRY and MORRISON (Feeds and Feeding) it has been proved, however, that yellow and white maize possess a uniform value as regards nutrition.

The white flat maize grown in Rhodesia has proved the best for the manufacture of alcohol and starch, and in the synthetic rubber industry. As regards yield, it has been noted that the old type flint variety, although excellent for the high veldts when early frosts are expected, has given only 455 bags (1 bag 200 lb.) per acre, compared with 10 to 12 bags for improved dent varieties. This should compensate for the slightly higher prices that may be offered for small flint maize on the export market.

M. L. Y.

685. **Nutritive Value of the Georgia Velvet Bean (1) (*Stizolobium deeringianum*) compared with Whole and Skimmed Milk.**

READ, J. W. and BARNET SURE (Department of Agricultural Chemistry, Arkansas Agricultural College) *Journal of Agricultural Research* Vol. XXIV, no 5, pp. 433-440, figs. 11, bibliography. Washington. D. C., 1923.

Report of a series of investigations made by the authors to determine the supplementary relationship of whole and skimmed milk to the hulled seed and whole plant of *Stizolobium deeringianum* and of the leaf and hulls to the seed. The great abundance of vitamine A and the deficiency in salts, in quality of protein and in vitamine B has previously been shown (*Journal of Agricultural Research*, Vol. 22, pp. 5-15 "Biological Analysis of the Seed of the Georgia Velvet Bean"). Results of the present experiments indicate that the velvet-bean seed (cooked) when fed at the rate of 60 % together with 40 % dextrin; and velvet bean hay (whole plant) fed at the rate of 40 % combined with 60 % starch will supply satisfactory supplement for milk, both for growth and reproduction. The leaf is not lacking in B vitamine and contains salts of excellent biological value; the hulls on the contrary have no supplementary value and interfere with the utilisation of the A vitamine in the seed. M. L. Y.

Breeding.

686. **The Laws of Heredity and the Breeding of Farm Animals.**

HUNT W. D. *New Zealand Journal of Agriculture*. Vol. XXVII, No. 2, pp. 103-111. Wellington, 1923.

The author draws attention to the importance of the stock breeder possessing marked ability in the selection of animals, as well as a knowledge of the laws of heredity.

The following is a brief record of results obtained by J. GIBSON the well-known Tasmanian breeder of Merino sheep, which are grown almost entirely for wool, the desire being to produce a sheep that would give the greatest amount of the best quality of wool. In 1868 he bred the ram Sir Thomas, the most noted Merino of his time; the heaviest fleece cut from this ram for twelve month's growth was 12 lb. The descendants of Sir Thomas, given in order, gave fleeces of the following weights respectively:— 14 lb., 17 lb., 18 lb., 20 lb., 26 lb., 23 lb., 27 lb., 30 lb., 36 $\frac{3}{4}$ lb.

Thus, in a little over thirty years by selecting those variations showing increased weight of wool, the weight was increased from 12 lb. to 36 $\frac{3}{4}$ lb., and this was done entirely within the flock without bringing in any outside blood.

The discoveries of MENDEL serve to explain the reason for many results, as for example, the fact that red calves sometimes appear in pure herds of black Aberdeen-Angus cattle. Black and red are Mendelian characters,

(1) See R. 1922, No. 369 (Ed.)